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DECEMBER CONTENTS

HIGHWAYS AND AIRPORTS

SEWERAGE AND SANITATION

WATER SUPPLY AND PURIFICATION

GENERAL

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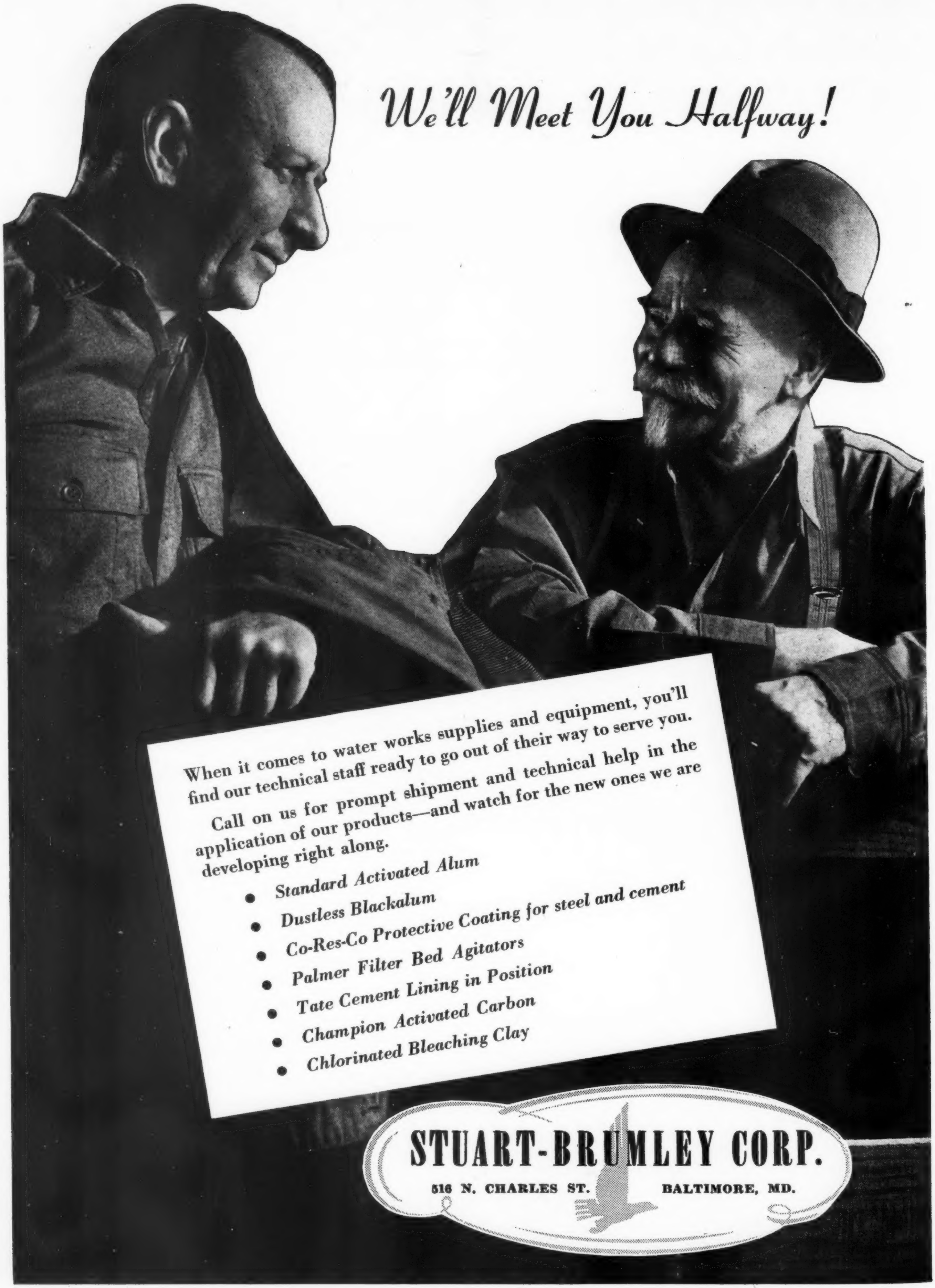
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The Editor's Page

What Is Sewage Treatment?

Our 2-ft., 10-pound dictionary says sewage treatment is "the process of removing and destroying or converting the noxious substances of sewage, especially by ammoniation and nitrification through bacterial action." In actual practice it is often far from this.

While realizing fully the burden of cost that a community has to bear, both in construction and in operation, for the disposal of its sewage, the fact remains that mere settling or straining of sewage is but partial treatment; it only *reduces* the nuisance and the burden that the receiving stream is called upon to bear. Also, it is an unfortunate fact that when primary treatment is installed with the announced intention of providing further treatment in the future, such additional treatment is invariably deferred—and deferred indefinitely. In other words, the provision of partial treatment, which may abate a nuisance and danger to health for the time, actually serves to perpetuate that nuisance and health hazard.

It will take a good many years, we fear, to educate health bodies and consulting engineers to a realization that temporizing with partial treatment is not necessary and results in an excessive delay in the construction of adequate sewage treatment plants. Right now is a good time to start getting out of our minds the idea that primary treatment alone is *really* sewage treatment, and to start a campaign for sure-enough sewage treatment.

If anyone is in doubt as to what we are thinking of, let him recall some of the campaigns and compacts and what-nots to clean up watersheds or drainage areas. In every case where compromise resulted in approval of primary treatment processes alone as a step toward complete treatment, the second step has never, to our knowledge, been taken.

The Emergency of Peace

The war can not continue forever; it may not end until 1950 or it may end next month. But when it does, practically every defense industry will stop instantly, and there will be the greatest labor emergency ever faced by the United States. And preparation for this emergency is second in importance only to that against the Axis powers. Therefore, even in our absorption in the latter we should not overlook provision for the former.

Such provision will be so stupendous a job that it will require the cooperation of all public authorities; and this implies a general coordination and supervision by some federal authority. The National Resources Planning Board seems logically to be the authority indicated, and it is taking active steps in assuming leadership in the matter. For eight years it has been studying the resources of the nation and its files contain data covering every known construction project that would provide employment and serve public needs. But to more definitely prepare for meeting the emergency of peace, this board has set up a Public Works Reserve, the object of which is to lay a basis for "a broad program of work projects that may be prosecuted after the reduction of defense activities. This operation shall be coordinated with the efforts of the Federal government to provide a six-year program and to encourage State and local agencies to prepare programs of public works."

More specifically, PWR aims to "accumulate an immediate listing of needed public projects as a reserve to absorb post-defense or emergency unemployment" in both construction and non-construction projects "developed at the State and local level"; to "assist State and local governmental units in assembling data and in preparing long-range public improvement programs based upon actual need," and in making "preliminary studies and surveys for selected important projects"; and "to relate the State and local programs of Federal agencies" with the construction projects referred to above.

It offers assistance, to as full an extent as is accepable to the State and local agencies, in this long-range programming. The listing of projects accumulated as the first step will immediately be made available to the Public Works Reserve office. In order that this list may represent the most useful and needed projects, local government officials will be asked to indicate their judgment as to priority and necessity, and the list will be kept up to date continuously, with an annual review "in order that needs may be constantly evaluated in the light of changing times, needs, and availability of more finished programming."

No indication has yet appeared that the Federal government will finance these programs; what Congress may decide later is anybody's guess. Therefore, financing must be considered by the State and local agencies in preparing their programs.

Already more than fifty cities have begun long-range planning of their public improvements to provide a reserve for post-defense use, and it is sincerely hoped that all public work agencies will do likewise, utilizing the offered assistance of the PWR.

The Public Works Engineers' Responsibility

In resigning as executive director of A.P.W.A. to serve as assistant director of the National Resources Planning Board, Frank W. Herring said: "Out of the international turmoil that now prevails there will come a new world, I am convinced; . . . a world as different from that of ten years ago as that world was different from the one our grandfathers knew; . . . one in which reason and fact will be more highly honored in the solution of society's problems. If I am correct, this means that the place of the public works engineer will be many times more important even than it has been during the past decade." And if, in accepting this responsibility, we are to bring credit to ourselves and honor to our profession as well as benefit our country, we must begin now to plan how best we can carry out these obligations.

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VOL. 72. NO. 12

Stone-faced reinforced concrete, rigid-frame bridge built in 1938. 70 ft. span. H-20 load. A 38 ft. roadway and two sidewalks.

Bridge Records in Mercer County, New Jersey

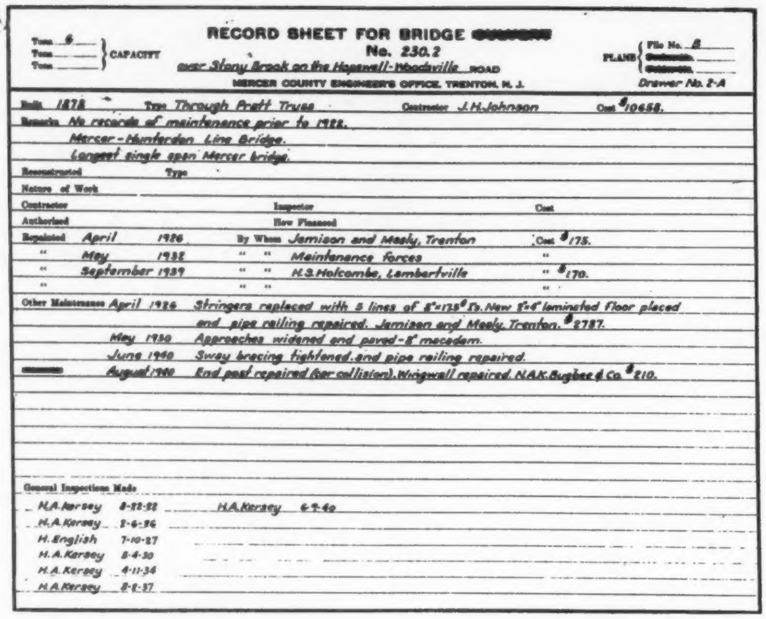
By HARRY F. HARRIS
M. Am. Soc. C. E. County Engineer, and

LESLIE R. SCHUREMAN
Assoc. M. Am. Soc. C. E. Bridge Designer
Mercer County, New Jersey

MERCER COUNTY, bordering on the Delaware river and lying at the crossroads between Philadelphia and New York, was created in 1838 from portions of four other counties whose settlement and development had begun more than one hundred and fifty years prior to that date. At the time of its formation, the county inherited from its parent counties the then existing system of public roads which lay within its boundaries, together with all bridges and culverts on those roads. The number of structures acquired by the county in this way is not definitely known but probably did not exceed a hundred at the very most. Through normal growth and ever-increasing traffic demands, the county has steadily built up its roster of bridges and culverts to the present-day total of approximately seven hundred. This number includes all bridges and culverts in the county except those which are either privately or state owned, and covers approximately thirty different types. Many of them have been in service for over fifty years and some for more than a hundred years. Of the bridges acquired when the county was formed, a few stone arches still stand and with proper care can be made to serve satisfactorily for some years more.

Stone arch bridge built about 1820. Its narrow roadway and poor alignment present serious hazards to modern traffic.

All of the older structures were, of course, designed for loads considerably lighter than those which have been in general use for the past several years. In many cases, weaknesses arising from faulty construction or inadequate maintenance in earlier years, or



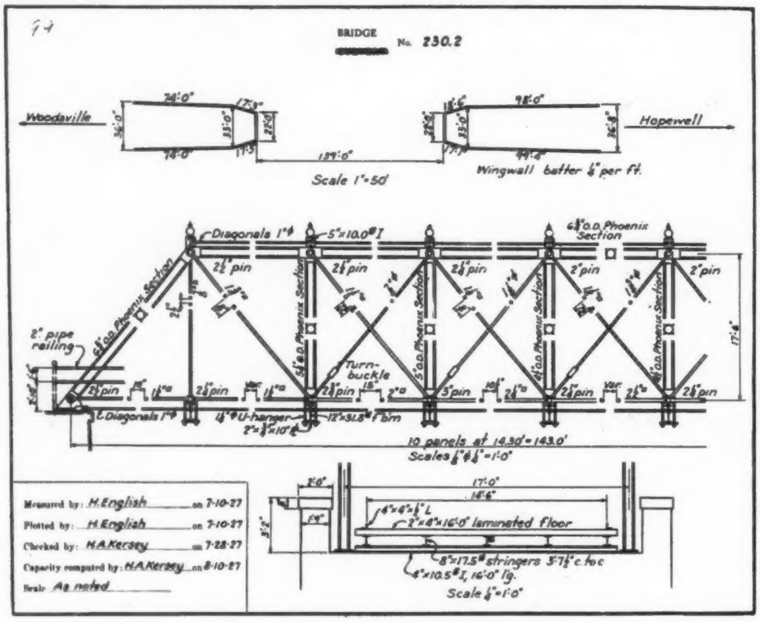
RECORD SHEET FOR BRIDGE [redacted]
No. 230.2
over Stony Brook on the Hopewell-Woodsville ROAD
MERCER COUNTY ENGINEER'S OFFICE, TRENTON, N. J.

Tons 6 } CAPACITY
Tons
Tons

PLANS { File No. 8
[redacted]
[redacted]
Drawer No. 2-A

Built 1878 Type Through Pratt Truss Contractor J.H.Johnson Cost $10658.
Remarks No records of maintenance prior to 1922.
Mercer-Hunterdon Line Bridge.
Longest single span Mercer bridge.
Reconstructed Type
Nature of Work
Contractor Inspector Cost
Authorized How Financed
Repainted April 1926 By Whom Jamison and Mealy, Trenton Cost $175.
" May 1932 " " Maintenance forces "
" September 1939 " " H.S.Holcombe, Lambertville " $170.
" " " "
Other Maintenance April 1926 Stringers replaced with 5 lines of 8"x17.5# Is. New 3"x4" laminated floor placed and pipe railing repaired. Jamison and Mealy, Trenton. $2787.
May 1930 Approaches widened and paved-8" macadam.
June 1940 Sway bracing tightened and pipe railing repaired.
[redacted] August 1940 End post repaired (car collision). Wingwall repaired. N.A.K.Bugbee & Co. $210.

General Inspections Made
H.A.Kersey 8-22-22 H.A.Kersey 6-9-40
H.A.Kersey 2-6-26
H.English 7-10-27
H.A.Kersey 8-4-30
H.A.Kersey 4-11-34
H.A.Kersey 8-2-37



Front and back of card for bridge No. 230.2.

a real problem in maintenance and maintenance scheduling. The way in which Mercer County is dealing with this problem is here described and may be of interest to other counties confronted with a similar situation.

The rapid development of motor truck transport led some years ago to a complete inventory of all county structures for the purpose of determining their physical conditions and load capacities and of forming a definite plan for their reconditioning and future maintenance. In order to expedite the work and to simplify the handling of the data obtained in the inventory, an identifying number was assigned to each bridge and culvert. The numbers were assigned in accordance with a definite system designed to be simple but effective in operation and as nearly foolproof as possible. This numbering system, which has proved to be invaluable and which the writers believe to be unique, is a modification of the "Dewey Index System" first used in the cataloguing of books in libraries and subsequently adapted to various forms of commercial indexing. As applied to Mercer County structures, the system makes it possible to locate, within narrow limits, any bridge or culvert from its number alone without referring to a map or written description. Each number has three digits to the left and either one or two digits to the right of the decimal point. The first digit indicates the township: the second, the watercourse, and the third, the principal tributary of the watercourse, zero being used for structures lying on the main stream. The figures to the right of the decimal point indicate the location on the stream, structures being numbered in sequence working upstream from the mouth. As an example, Bridge No. 542.7 is shown by its number to be in Lawrence Township (5) and to be the seventh structure on the second principal tributary of Assunpink Creek (4). For exact location, a "bridge location map" is used. This is simply a county map on which each bridge and culvert has been spotted and marked with its identifying number. For field identification, a metal plate attached to each structure bears its number.

both, still further limit load carrying capacities. In spite of prominently posted load limits, these structures are being continually subjected to heavy overloads. The clearing of land and the expansion of urban areas have so increased storm run-off in parts of the county that spans and clearances originally adequate for flood flow have become inadequate. Flooding and scouring have occurred in severe storms with more or less damage to adjoining lands, approaches and substructures. Narrow roadway widths and approach alignments designed for horse drawn vehicles present positive hazards to modern high-speed motor traffic. Obviously the only remedies for situations of this kind are widening and curve easement where practicable or, more frequently, complete reconstruction on new alignment.

These inadequate, obsolete bridges are being replaced with modern structures as rapidly as available funds will permit. In the meantime, the task of keeping them in safe working order obviously constitutes

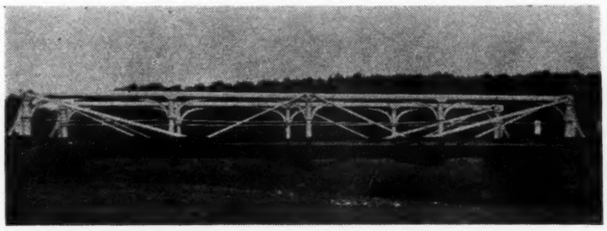
As the inventory progressed, a card file system was begun which today serves as the basic control for all matters relating to county structures. In this file each structure is concisely but fully described on a 9" x 11" card. One side of the card contains the number of the structure, the name of the road and stream on which it is located, the date built, the cost of construction (if obtainable), the type of structure, the load capacity, inspection dates and remarks, maintenance entries and other pertinent data. The reverse side contains the number of the structure, a scale sketch with principal dimensions, flood stage (if available) and notations regarding original recording as well as revisions.

Periodic inspections of all except the larger structures are made by the maintenance department. Minor

defects are noted and remedied in their turn by the maintenance forces and then reported on standard forms to the engineering office for entry on the record cards. Repairs or renewals requiring engineering analysis are referred to the engineering office for study and recommendation. In these cases, the repairing or renewing is done under either contract, formal or informal, or by the maintenance forces, depending upon the size of the job. Where complete reconstruction is indicated, temporary repairs are made and the structure listed for consideration in the next year's replacement program.

The larger structures are regularly inspected by qualified members of the engineering staff and necessary repairs made under contract. The county has had only one bridge failure in the nearly twenty years of operation of the present system, a record of which it is justly proud. This failure was caused by the collision of an automobile with one of the end posts of an aged truss bridge and was in no way due to inadequate maintenance. By entering all repairs, improvements and renewals on the record cards as they are made, a complete and up-to-date history of each structure is made available at all times.

Considerable difficulty was encountered in collecting the original data required for the card records because neither plans, specifications nor any other record could be found for many of the older structures. Although Mercer County was incorporated in 1838, it was not until 1903 that specific provision was made for the preservation of engineering records. In the early years of the county's existence, as was the common practice at that time, roads and bridges alike were planned and constructed by individuals appointed by the county authorities as the need arose for the particular job at hand. The plans and specifications, if any, apparently remained with the parties connected with the job. It was not until 1893 that the county road and bridge work was placed in the hands of a regularly appointed engineer and not until some years later that recording and filing facilities were provided. (In passing, it might be remarked that the practice of appointing county engineers for a term began with, and was one of the indirect results of, the enactment of the State Aid road laws in New Jersey. The principal duty of the county engineer in those early days, however, was to supply the necessary engineering for the construction of macadam roads.) It was therefore necessary to send out field corps to obtain the required data for many of the record cards. In many cases, all facts concerning original construction could not be obtained. It was possible, however, to approximate the age of most of the bridges from their type and the character of their construction. In spite of these and other minor difficulties, the record stands today as complete as is necessary for all practical purposes. For the past several years it has been the policy to obtain and file photographs of individual structures showing conditions before and after improvement or replacement. These photographs have proven to be a useful adjunct to the card record and also provide a valuable historical record. More recently a further addition has been made to the system in the form of a tabulation of all county structures arranged according to type and giving their salient features. The tabulation was made directly from the record card file and is used principally for ready reference and in connection with general planning and administration.



Fink truss bridge—an unusual type built in 1858 at another location; in service since 1883 at its present site. Span 60 ft.

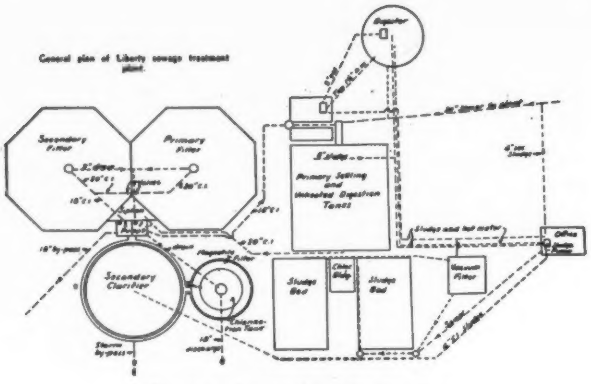
A light, narrow truss bridge built in 1888. Posted capacity 4 tons. Typical of a number of similar structures built about this period.

A reinforced concrete continuous slab on precast pile bents, recently opened to traffic. Designed for H-20 loading with a 38 ft. roadway and two sidewalks. Total length about 80 ft.

The system, although originally installed as an aid to efficient maintenance, has become indispensable to other phases of the bridge department's work. It furnishes an overall view of the bridge needs of the county, which is extremely helpful in long range planning. In yearly programming and budgeting, it supplies dependable factual testimony concerning the relative urgencies of proposed projects and is of great assistance in preliminary design, construction and cost studies. It has proven to be of value recently in routing army transport units and equipment. A short time ago the county, on request, furnished military authorities with information concerning the load-carrying capacities of bridges and culverts on all principal county and township roads for the purpose of routing army equipment to and from Fort Dix. A similar service is frequently rendered to industrial and trucking concerns for routing heavy loads.

The real value of the system to the efficient conduct of all matters, large and small, relative to county structures, can be fully appreciated only by those engaged in this type of work. It should, however, be apparent to all that the very large investment of public funds represented by the county's bridges and culverts can best be protected and most efficiently managed only by such means.

The entire system was devised and installed by the senior writer and is maintained and administered by Harry A. Kersey, Assistant Engineer of Bridges. Routine inspection and maintenance is in charge of William R. Sharp. Freeholder Leonard A. Plant is Director of the Department of Bridges and Culverts.



General plan of the Liberty plant.

The First Year of O

By JOHN LAWRENCE and HARRY EICHENAUER

Superintendent of Public Works and Operator,
Sewage Treatment Plant, Liberty, N. Y.

THE biofilter at Liberty, N. Y., was the first to be constructed in the east, and it is still the largest municipal plant in that section, though some larger plants of this type have been constructed to serve army posts. The plant began operation in late August, 1940, and data are now available showing the results of operation through September, 1941.

General Description of Plant

The plant consists of a Link-Belt Tritor screen; rectangular settling tanks (built in 1931) which are equipped with Link-Belt Straight-Line sludge collectors; two 80-ft. diameter Biofilters, 3 feet deep, with Dorr distributors; a secondary settling tank with a Dorr clarifier; a magnetite filter; a Dorr digester; and covered sludge beds. The plant is designed for a flow of 1 mgd with a B.O.D. of 425 ppm. Utilizing a recirculation of 2:1, the detention period in the primary tank is 70 minutes and in the secondary tank 1 hour; the rate of application to the filters is approximately 13 mgad. It is believed that this is the first plant to utilize the principle of a constant volume of recirculation irrespective of the raw sewage flow, thus permitting recirculation pumps to operate continuously under uniform head and load conditions. The plant was designed by W. A. Hardenbergh. It was described in the July, 1940, issue of PUBLIC WORKS, and additional data were published in the October, 1940, issue. The accompanying sketch shows the layout of the plant.

General Operation Data

From late August, 1940, to Nov. 16, 1940, the plant was operated as a Biofilter; from Nov. 16, 1940, to April 19, 1941, it was operated as a straight trickling filter. From April 19 to Sept. 15, it was operated as a Biofilter; on Sept. 15, 1941, recirculation to the primary tank was stopped, and since that time the settled sewage, without recirculation, has been applied to the primary filter, with recirculation only to the secondary filter.

While this last method appears promising, it is too early to determine definitely what the final results will be. Experience seems to indicate that when a change in method of operation is made, four to six weeks must elapse before reliable results are obtained; that is, this length of time is required for the bacterial life on the filter media to become fully adjusted to the changed conditions. Results following a change in method of operation should not therefore be accepted until an ample period has elapsed.

This time characteristic may indicate the advisability of a uniform procedure in operation; it is doubted that good results will be obtained if any other course is followed. On one or two occasions when power failure has resulted in stopping recirculation for 18 to 24 hours, there seemed to be a depreciation in the quality of the effluent. On the other hand, exceedingly heavy loads of milk waste, coloring the sewage strongly, and of laundry waste do not appear to affect the quality of the effluent; neither does the super-

Date 1940-41	Flow MGD	Biochemical Oxygen Demand		Suspended Solids		D. O. in Final Eff.
		Raw	Secondary Clarifier	Raw	Secondary Clarifier	
12/6	-	325	39	308	31	5.6
12/11	-	385	36	288	23	-
12/26	-	345	20	244	23	6.0
1/8	0.75	280	37	180	23	6.4
1/21	0.70	320	44	192	31	4.2
1/24	0.60	325	37	152	13	4.2
1/31	0.60	255	50	200	14	2.2
2/6	0.60	720	56	448	20	2.2
2/13	0.70	200	31	228	23	4.2
2/19	0.60	300	51	156	16	5.4
2/24	0.60	330	56	192	20	3.0
2/28	0.60	320	30	156	18	2.8
3/5	0.70	210	52	110	23	5.8
3/11	0.60	260	55	156	40	4.2
3/14	0.60	297	45	184	13	2.4
3/24	0.70	200	17	124	11	5.9
4/8	0.70	210	54	120	21	4.4
4/14	0.60	290	68	180	34	2.8

Data while operating as a straight trickling filter.

Date 1940	Flow MGD	Biochemical Oxygen Demand			Suspended Solids			D. O. in Final Eff.
		Raw	Secondary Clarifier	Final	Raw	Secondary Clarifier	Final	
8/30	0.72	120	20	10	216	32	15	5.4
9/2	1.34	140	29	21	104	23	12	4.9
9/3	1.04	350	23	10	123	19	8	5.5
9/4	0.92	140	27	8	161	23	8	5.0
9/5	0.85	180	21	13	128	20	6	5.1
9/14	0.75	380	16	14	196	16	-	6.3
9/19	0.75	320	9	4	160	7	1	6.4
9/23	0.75	280	10	1	232	-	2	6.4
9/26	0.80	210	11	3	164	9	2	7.4
9/29	0.75	430	10	3	220	4	2	7.5
9/30	-	450	9	2.5	224	5	1	6.8
10/1	-	380	10	4	240	8	2.5	6.8
10/10	-	250	9	2.5	232	5	1	6.4
10/16	-	240	11	8	264	10	2.5	6.8

Data while operating as a biofilter.

Operation of the Liberty Biofilter Plant

Operating data of this plant when operated as a biofilter, as a straight trickling filter, and with recirculation to the secondary filter only.

natant return, though this is, at times, heavy and strong.

Data on Tests

The procedures described in Standard Methods are used uniformly in performing all tests. All results reported are on daytime composites, as follows: Raw sewage, composites from 8 A.M. to 2 P.M.; effluent from 9 A.M. to 3 P.M.; intermediate samples at periods in between. This procedure is followed because an operator is present for only 9 hours a day, the plant being unattended during the night. It is believed that 24-hour composites would show lower results throughout, from raw sewage to final effluent.

Operation data from Aug. 30, 1940, to Oct. 16, 1940, during which time the plant operated as a Biofilter, are as follows:

The samples for the period Aug. 30 to Sept. 5, inclusive, were 24-hour composites. A heavy rain on the 30th and 31st of August preventing sampling. It is not believed that the results prior to Sept. 15 indicate what the plant will do, as about 4 weeks are normally required after recirculation is started to obtain good results. The characteristic dark green color of growth on the filters does not appear prior to this time, as a rule. Some ponding occurred during the first 3 weeks of operation on the secondary filter, but had practically disappeared by Sept. 15.

It is understood that these same general characteristics have appeared on other Biofilters, including those serving army posts. There is pooling and ponding followed by heavy growths of stringy algae in some cases; the ponding then disappears and the filter surface turns a dark green.

Operation as a Trickling Filter

On Nov. 16, 1940, recirculation was discontinued and the plant operated as a straight trickling filter. No tests were made from Oct. 16 to Dec. 6, due to moving the laboratory to another building. Operation of the magnetite filter was also discontinued on Nov. 16. Results of operation during this period, which lasted until April 19, 1941, when recirculation was again begun, are as follows:

During this period, the average B.O.D. loading of the filter, without allowance for weaker night sewage (all these samples are 8-2 and 9-3 composites) was 1.32 pounds per cubic yard. The average effluent B.O.D. was 44 ppm, and the average effluent suspended solids was 22 ppm.

Operation from April 19, 1941, to Oct. 1, 1941

On April 19, 1941, recirculation was again started. Irregular and erratic results were obtained, with some ponding on the secondary filter until May 31, when the secondary filter unloaded. Thereafter, greatly improved operation resulted. Somewhat more detailed results of operation are given for the 1941 season, as shown in the table above.

Date 1941	Flow MGD	Biochemical Oxygen Demand: Raw	Pri. Eff.	Pri. Filt. Eff.	Sec. Filt. Inf.	Sec. Cl. Eff.	Final Eff.	Suspended Solids Final	D. O. Final
4/23	0.60	400	-	-	-	36	32	12	-
4/28	0.70	420	-	-	-	31	21	16	1.6
5/5	0.60	500	165	-	-	30	23	6	0.4
5/9	0.65	390	160	-	-	38	23	25	1.4
5/13	0.60	520	190	-	-	28	8	12	4.8
5/21	0.60	320	115	36	13*	14	9	7	4.2
5/26	0.62	500	198	-	43*	24	10	4	4.0
5/31	0.65	470	189	-	-	55	-	32	3.2
6/4	0.81	390	186	86	25*	27	8.5	13	4.8
6/10	0.62	455	176	84	28*	22.5	7	13	6.6
6/13	0.68	390	145	104	62	25	7.5	10	6.4
6/16	0.62	520	164	120	68	24	10	12	6.2
6/24	0.62	560	175	76	55	32	14	12	5.4
6/28	0.62	500	170	120	57	23	12.5	20	4.6
7/5	0.81	450	207	102	61	31.5	13	11	4.2
7/8	0.88	500	240	157	64	29	13.5	6	3.8
7/11	0.81	460	210	145	64	28	13	11	3.8
7/14	0.81	520	197	163	58	19	13.5	15	4.2
7/17	0.81	310	130	173	43	17	6	5	4.4
7/23	0.75	310	210	185	55	19	5.5	2	3.6
7/26	0.95	400	142	136	66	14.5	5.	3	4.0
8/1	0.95	410	155	112	40	18	6	3	3.8
8/4	0.88	390	212	146	76	19	6	6	4.0
8/8	0.88	410	220	203	86	20	8	9	3.8
8/12	0.88	320	235	140	77	15	5.5	1	3.8
8/14	0.82	530	226	180	68	19	4.8	5	-
8/20	0.82	460	220	131	88	31	12	9	3.8
8/23	0.82	490	195	122	56	19	6	3	5.6
8/29	0.82	560	210	125	56	19	6	2	5.8
9/2	0.82	440	156	128	45	15.5	6	5	5.8
9/5	0.75	500	154	125	52	15	6	6	5.6
9/8	0.75	470	270	112	72	-	-	12	5.2
9/12	0.68	460	148	80	33	14.5	5.5	5	6.8
9/17	0.68	360	245	85	48	13.5	8.5	5	6.2
9/20	0.68	390	243	65	56	17.5	7.5	5	6.4
9/23	0.75	450	250	90	47	18	6.5	5.5	6.0
9/26	0.68	460	256	85	41	16	7.5	3	6.4
10/2	0.68	500	290	95	63	26	5.8	1	7.0
10/10	0.75	480	238	90	48	24	6.2	5	7.2
10/14	0.62	460	265	80	40	23	4.4	2	7.2
10/22	0.81	380	268	120	79	18	6.9	3	7.0
10/27	0.56	360	235	105	42	15	6.0	2.5	8.2
10/30	0.56	360	225	108	56	19	4.6	5	7.8

Detailed results of operation during the 1941 season.

(Continued on page 41)

Installing and Operating

By H. M. FRYE
Plant Superintendent, Blackwell, Oklahoma

BEFORE taking up the subject of settling basin baffles the Blackwell waterworks will be described briefly, pointing out some methods used at the plant which may be helpful to other plant operators. The water is a surface supply which is treated by coagulation, both pre- and post-chlorination, primary and secondary sedimentation, aeration and filtration. The plant includes Dorr clarifiers, mixing chambers, solution chemical feeders, W & T chlorine-ammonia equipment, and six filters. Aluminum sulphate is used as coagulant and hydrated lime for alkalinity correction.

Water is taken from two separate diversion dams across the Chicaska River, at each of which a pump sends it through one of two 16" pipe lines to the plant in the city, from which these pumps are operated by

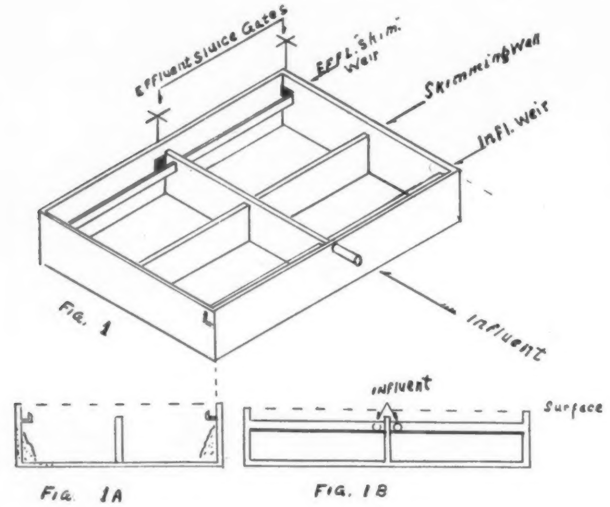


Fig. 1—General design of settling basin and baffles.

remote control, which gives satisfactory service and saves a pumper's salary. When the river flow is insufficient, water is discharged above the dams from a storage reservoir. The water purification and power plants occupy the same building site in the city, and both are operated by the same force, the chemical dosage and general operation being regulated by the supervisor.

The applied water enters settling basins designed as in Figs. 1-1A-1B. These have a center cross wall extending within two or three feet of the surface, providing for skimming and preventing excessive straight line forward movement and "channeling"; also a central longitudinal wall dividing the basin into two equal parts, either of which can be cleaned while the other is operating. The basin effluent is pumped through the steam turbine condensers as cooling water, then flows through a spray nozzle system over the secondary settling basins. When the primary basins do not furnish an adequate supply of cooling water, this is supplemented by returning the necessary amount from the secondary basins. Aeration releases CO_2 and odors due to destruction of micro-organisms by prechlorination, this the more readily because of the temperature rise of the water due to passing it through the condensers.

Action of Settling Basins

It is obvious that, with water both entering and leaving the basin over weirs near the surface, almost all the water circulation is above these weirs, and above the skimming wall if there be one. In the great majority of settling basins the top 15" to 24" of the water is about all that is moved by skimming action; the depth being governed by that of the influent and effluent weirs, which ranges from 12" to 24" in this section of the country. As water to about this depth, which may be called the settling zone, moves slowly across the basin, the contained solids settle slowly. The forward motion of the water in a straight line may result in "channeling" and should not persist for too great a distance; furthermore, after the suspended matter has settled below a certain horizontal plane it

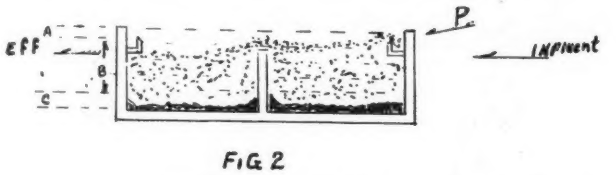


FIG 2

A—Depth of settled water utilized. B—Water used as suspended solids path. C—Sludge zone. P—Horizontal plane of settling suspended matter.

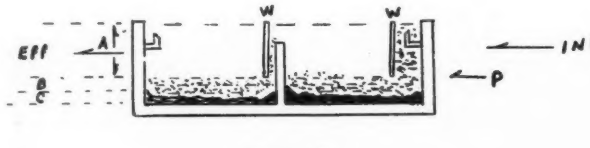
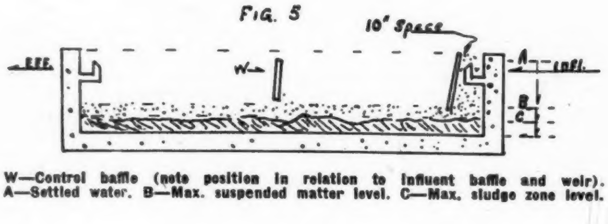


FIG 3

WW—Baffles. A-B-C-P—See Fig. 2.

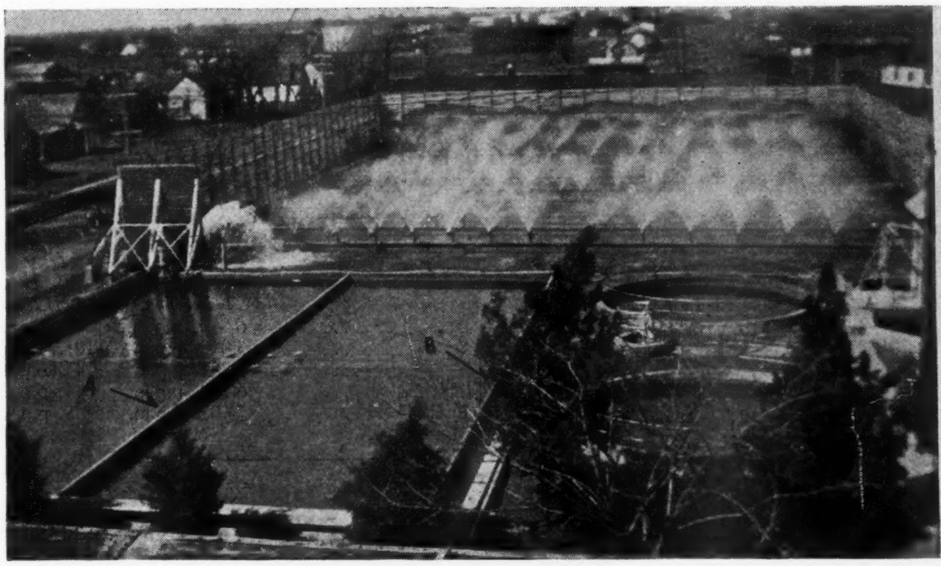
FIG. 5



W—Control baffle (note position in relation to influent baffle and weir). A—Settled water. B—Max. suspended matter level. C—Max. sludge zone level.

A Settling Basin Baffle System

The use of baffles and skimming walls to create a deeper settling zone and increase settling capacity. Suggestions for methods of constructing baffles.



Settlng basins of Blackwell plant. A—Baffle on effluent side of skimming wall. B—Baffle in front of influent weir. Aerators in the background.

After cleaning, 25,000 cu. ft. (almost 5 ft. deep) was removed.

is not desirable to let it rise above this plane while traveling further in the same direction.

The water below the settling zone down to the sludge zone serves no purpose except to act as a dead mass through which the suspended matter passes to the sludge. The water in this zone (usually 6 to 10 ft. deep) is fully capable of settling but is continuously contaminated by suspended matter from above so long as the water is moving through the settling zone.

If water-tight baffle walls be placed in front of the influent weir and the skimming wall, extending from above water level to within a foot of the sludge zone at its maximum depth, the influent enters the basin near the sludge zone, and the flocculated suspended matter in the influent has a much shorter distance to settle to reach the sludge zone and, once settled, will not rise again into the water above; and will not be carried up by the clarified water as it rises to pass over the skimming wall or effluent weir if it is such as would have settled from that level before the baffle installation. In fact, such rising is less probable than settling, and with the use of baffle walls a lighter floc should settle to the sludge zone than without them, permitting a saving in coagulation chemical.

Before cleaning. Sludge within one foot of baffle wall.

By constructing baffle walls, a basin with a skimming wall is converted into a multi-stage basin and both capacity and settling time are increased. Instead of 15″ to 24″ of water at the surface being settled and removed as clarified effluent, the top 6 or 7 ft. are clarified.

In the case of a basin without a skimming wall a baffle should be placed midway between the influent and effluent openings to aid in maintaining suspended solids at the same horizontal plane as the bottom of the baffle wall. In this case the center baffle should act as a combination skimmer and control wall, being constructed with the bottom one foot higher than that of the influent baffle and the top one foot lower than the level of the influent weir.

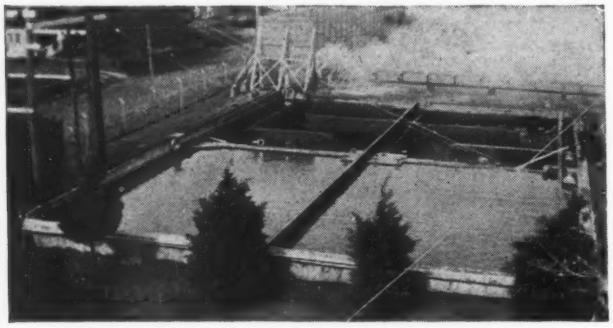


Fig. 4. Primary basins; further half drained for cleaning. Water clarity permits seeing walls submerged 1 ft. (Barely visible in the cut.)

Construction

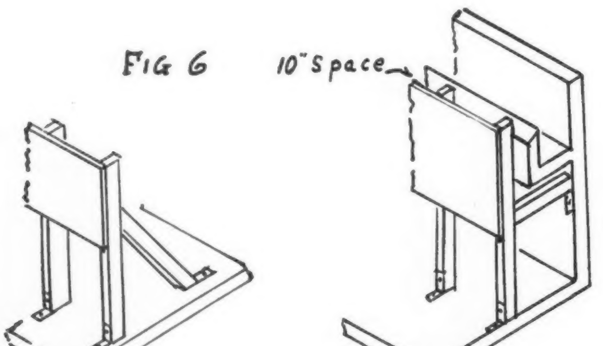
Any one of a number of materials may be used for construction of baffles—concrete, galvanized metal, wood, sheet transite, etc. Wood is the most economical, especially for basins in service. Redwood or cypress lumber is the most suitable; however, fir is quite satisfactory, and lower in price. A protective coating should be put on parts exposed to the weather.

As there is no pressure against the walls, only rigid support and anchorage are necessary. Every third stud in the frame work may extend to the basin bottom to serve as a support and anchorage leg, if wood is used. Bracing to the influent weir wall, or to the basin bottom, is shown in Fig. 6 in sufficient detail.

There should be a 10-in. space between the baffle and the influent side of the weir, or skimming wall, with an incline of 2" per foot of depth.

The baffle walls constructed at the Blackwell plant were of fir tongue-and-groove car siding, with 2" by 4" dimension lumber used for framework. The basins are 12½ ft. deep and the baffles extend from the top to within 5½ ft. of bottom. They are water tight Sludge is allowed to collect 4½ ft. deep before cleaning. During the six months the baffles have been installed, there has been a 20% reduction of coagulant from previous dosages, in addition to greater clarification and longer filter runs.

In order to study the practical achievements of these baffle walls, a model may be built to scale similar to the basins in use. The two sides of the model parallel to the movement of the water in the basins should be of plate glass in order to study settling action. By operating the model without baffle walls, then with them, under similar conditions, quite accurate comparisons can be observed.



Methods of installing baffles. Left—"Combination" baffle, midway service. Right—Influent weir or skimming wall baffle.

Disposal of Filter Wash Water

The State Water Commission of Connecticut, in reporting on the pollution of streams by wastes, finds that the wash water from water filtration plants is very objectionable in some cases. It refers to this as follows:

"The gelatinous floc produced by precipitation of alum on sand filters adsorbs and retains an amount of organic matter, which causes it to approach the composition of sewage. A large volume of this material, discharged rapidly to a small stream, produces objectionable conditions along the banks and in ponds. When such material finds its way to larger bodies of water, used for recreational purposes, it produces objectionable effects which are notably persistent. It was found that the volume of this material could be reduced by modified processes of flocculation, and that the major portion of the solid matter can be removed by sedimentation in a supplementary settling basin from which the settled material can be removed and disposed of by filtration on sand beds, or with mechanical filters. In this way the normal flow of a small stream is equalized and maintained, as in some cases the water removed with the floc is an important factor in normal stream flow.

A typical waste of this character shows the following composition:

	Before filtration pH 6.54	*After filtration pH 6.4*
Total Solids	6,899. p.p.m.	146. p.p.m.
Fixed Solids	3,012. p.p.m.	101. p.p.m.
Volatile Solids	3,882. p.p.m.	45. p.p.m.
Suspended Solids	6,790. p.p.m.	4. p.p.m
5-day B. O. D.	103. p.p.m.	5. p.p.m.
10-day B. O. D.	216. p.p.m.	....

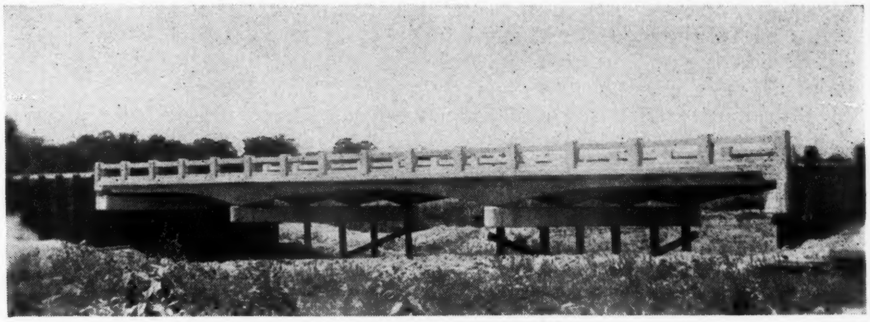
Water Softening Sludge At Kankakee

The Kankakee Water Co. uses the lime-soda process for softening river water that averages about 20 grains hardness. Disposing of the sludge is a problem. Discharge into the river, the practice at first, formed sludge bars and was discontinued, and two basins were excavated adjoining the plant, of 1,000 and 1,250 cu. yd. capacity, respectively. Sludge is drawn into one daily and, when it is full, into the other while the first is drying. During winter the sludge freezes solid and at times has to be broken up by blasting and removed as ice, and dumped into an abandoned quarry about two miles away.

Dried sludge is used by farmers as a soil conditioner. It is removed from the basins by means of a drag line bucket operated by a steam winch and loaded into the farmers' trucks without charge.

Frost Casing a Riser Pipe

Cooperstown, N. D., out where winter is winter, keeps the water in the riser pipe to its elevated waterworks tank in a liquid condition by means of a frost casing, built with WPA labor at a cost of $550. At the bottom is a building 10 ft. square and 8 ft. high, built of cement blocks, that houses a coal stove. Above this, surrounding the pipe, is a casing octagonal in shape, 8 ft. diameter and 96 ft. high, resting on two parallel 10" I-beams that are supported by the walls of the building and extending to the bottom of the tank. A door near the top allows for ventilation. The casing is of planks, lined inside with ¾" celotex and outside with asphalt wool paper covered with corrugated iron. A ladder is built on the inside. The cost of heating runs about $30 a year.



The finished three-span bridge.

Careful Planning and Training Of WPA Workers

By E. G. HURST
County Engineer, Montgomery County, Illinois

IN Illinois, one cent of the State gasoline tax is allocated to the counties for the construction of State Aid roads, to be spent under guidance of the State Highway Dept., which approves all designs, specifications and contracts. On WPA projects this motor fuel tax may be used for purchase of materials, rental of equipment (on a scale set by the State Highway Dept.) and any skilled labor required that cannot be supplied by WPA. Believing that a combination of this source of revenue with WPA labor could be used to financial advantage, Montgomery County carefully planned a schedule of work, one feature of which was the training of the WPA labor by first employing them on simple construction, following this by projects in which increasing degrees of experience and skill were necessary.

The projects selected were those highway ones on which motor fuel tax funds could be used and which could be incorporated into a county-wide WPA project. The county purchased the necessary equipment, for which rental was paid from the gasoline tax. Since WPA furnished the labor only, the county received credit for amounts allowed for equipment, which credit was utilized to carry sponsorships on projects not chargeable to the motor fuel tax, producing quite a saving for the county road and bridge fund.

Twin 60-inch culvert.

The initial project was 3 miles of grading and surfacing, including almost every type of drainage structure, from small deformed pipe arches to large skewed pipe arches with concrete footings and several box culverts. For building these drainage structures a crew of selected men was organized, and the county purchased a 2-bag concrete mixer mounted on rubber-tired wheels, rebuilt a bus into a movable office and tool shed, and furnished a 1½ ton truck to pull these as trailers from job to job.

Skew pipe arch on concrete footing.

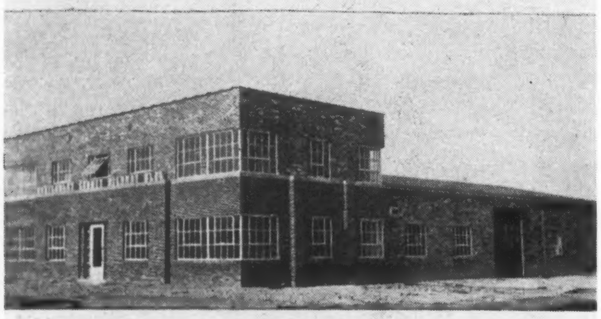
Using this mobile outfit, this crew started on small concrete culverts on township and county roads which could not be done with motor fuel tax funds; then moved successively to larger structures all over the county; and when WPA work began on the motor fuel tax section, this crew was thoroughly familiar with small structures and competent form setters and steel workers, their work comparing favorably, in both excellence of construction and cost, with that of any contractor.

The M. F. T. work included 25,000 cu. yd. of excavation, and to handle this the county purchased a large

motor patrol and a Diesel tractor equipped with 6-yd. scoop, and furnished a truck. Also included in this work were hedge pulling, clearing and grubbing, and 4,000 cu. yd. of crushed stone surfacing, in addition to the drainage structures already mentioned. The cost of this work, not including WPA labor, was $11,361.75 for grading, drainage structures, etc. and $8,452.22 for surfacing. The estimated costs by contract were $21,224.05 and $14,385.42 respectively, showing savings of $9,862.30 on the former and $5,933.20 on the latter. The cost per cu. yd. for excavation was 25c as compared to contract price of 36c; and placing surfacing material cost $2.15 per cu. yd. as compared to the estimated contract price of $3.43. Moreover, $5,403.81 of the money spent was equipment rental paid to the county from M. F. T. funds; and as the tractor, scoop and motor patrol did not deteriorate excessively, a part of this can be figured as savings; making the total savings about 50%.

Constructing a Three-Span Bridge

During this construction, two more jobs were being planned—a three-span concrete bridge and an office building for county highway use. The job just described included 2,000 ft. of curb and gutter, and as soon as the culvert crew had finished this they began work on a 20 ft. span I-beam bridge with concrete deck, which was constructed on a minor county highway in about six weeks and gave further experience to the crew before starting on the larger bridge, which has two 36 ft. spans and one 50 ft. For this, a continuous concrete beam structure was selected rather than an I-beam or steel truss, to save on material cost. Instead of standard steel hand rail, a precast concrete rail was designed. The county did not own a rig to drive concrete or steel piles, so the bridge was supported by bents of creosote piling with concrete caps; although a further saving in material cost could have been made by using precast concrete piling, and for future construction of this nature the county will purchase or rent equipment for driving concrete piling.



Top—Forms for middle and north span of bridge. Middle—County highway building. Bottom — Interior of garage, showing wood trusses.

The false work for supporting the concrete floor forms was so designed as to use 14 ft. lengths of 8 x 2½ in. white oak boards; three of which, bolted together every 2 ft. but not otherwise harmed, were used for each beam. This particular size was used because such timber could afterward be used by the county in repairing wooden bridge floors and culverts. Also the bridge spans were so designed that the ply-wood forms might be utilized at some future date for single span construction; and for this reason more expensive ply-wood was purchased, unusual care taken in cutting it, all braces were wired and notched instead of nailed, and forms were oiled.

Special stress was placed on the organization of the men, and the braces, beams and forms were cut and placed with almost assembly line schedule. Since it was a continuous-span bridge it was necessary to pour the entire 140 cu. yd. of concrete in the superstructure monolithically. A two-bag mixer was placed at each end of the bridge, with a complete crew for each, and each crew placed concrete continuously, beginning at the center and working toward its end. The total mixing time was about 8 hours. The bridge approaches were 500 ft. long and contained 18,747 cu. yd., which was hauled about 800 ft. from borrow pits. The total cost of the approaches to the county was only 18c per cubic yard.

Considerable saving in man-hours was effected by constructing a temporary bridge near the new structure by which men could pass and material could be carried across the stream; this bridge consisting of old ½″ cable threaded through 2″ x 6″ stringers and fastened to stumps on the opposite banks; the total cost for material and labor being only $12.40.

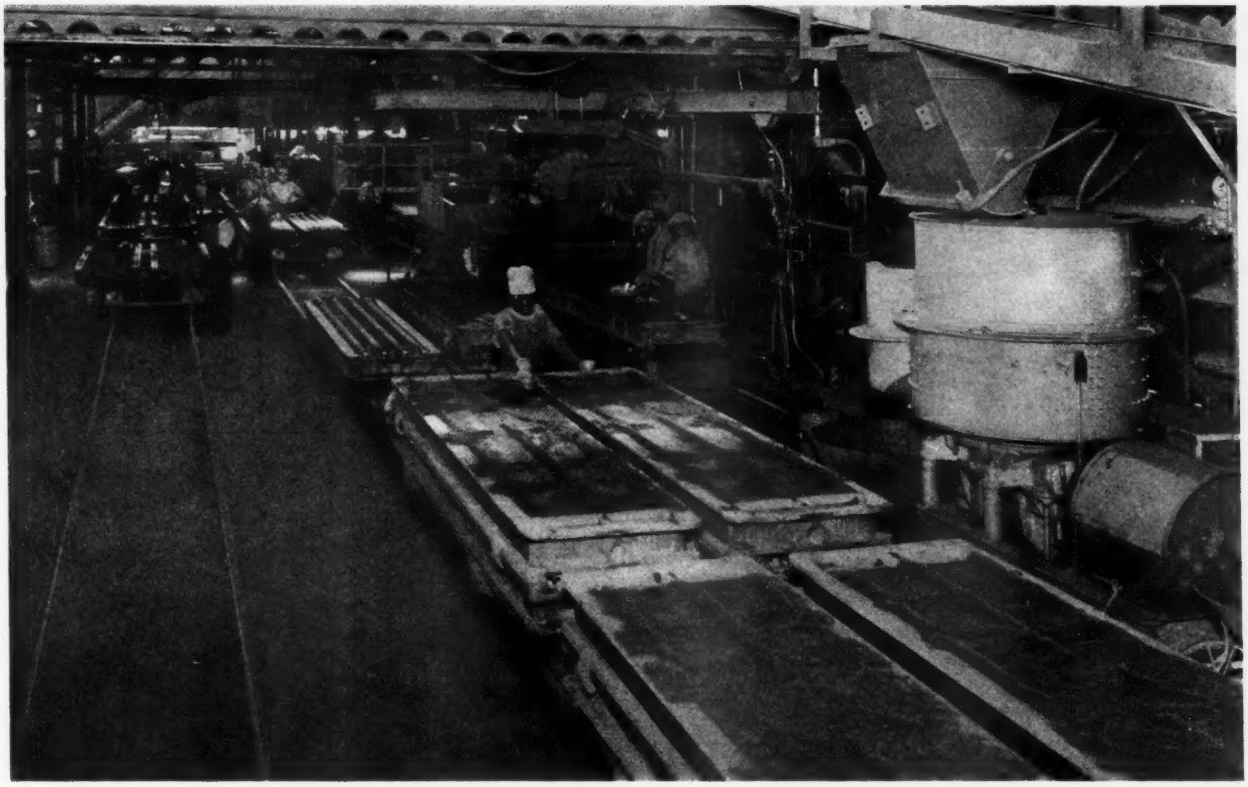
This construction was begun in November 1940 and completed in April 1941. During this period the Defense program began to affect steel production, and if it had been necessary to purchase beams for a steel structure there undoubtedly would have been delay and at least 25% increase in cost.

The total cost of the concrete, including the forms (which were completely salvaged for further use) and 8 cu. yd. of pre-cast hand rail, was $20.40 per cu. yd., as compared to $30 contract estimate. The total cost to the county M. F. T. funds was $8,873.17, which was $8,181.02 below the contract estimate. Of the total cost, $2,879.11 was returned to the county funds for equipment rental.

Constructing an Office Building

During the fall of 1940 we planned the construction of a 2-story office building and garage for county

(Continued on page 35)



General interior view, new 2-inch pipe shop of McWane Company.

Streamlining a Pipe Shop

By ARTHUR K. AKERS

Defense demands have brought assembly-line methods into pipe making in the new world's largest 2-inch cast iron pipe foundry, in Birmingham.

UNDER the impact of vast defense activities in many communities throughout America, the demand for small-size cast-iron water and gas pipe has mounted until it became a question of additional plants or getting far more production from existing ones. How one company met the situation by mechanical innovations that brought the assembly-line methods of other industries into pipe-making, and thereby stepped up production until it has developed the largest 2-inch pipe casting shop in the world, is told here. This description will, we believe, be welcomed by waterworks engineers not only because of its timely interest but also because *how* a product is made has much bearing on how it will perform afterwards.

It may be recalled that some years ago (May 1936) PUBLIC WORKS published an article on the initial adaptation of mechanical casting as practised in large commercial foundries to the then-new 2-inch pipe shop of the McWane Cast Iron Pipe Company. Since then, under the demands of new army camps, air fields, munitions plants, and housing developments around them, this capacity grew insufficient and even greater production became imperative; for some of these facilities for preparedness required as much water pipe as a medium-sized city, especially in the smaller pipe diameters.

This of course was due to the temporary nature of much of the construction, coupled with the fact that low-cost real estate development for labor near such centers added to the demand for domestic water supply over wide but comparatively thinly-populated areas. A salvageable pipe that would be low in initial cost yet could be quickly and economically laid, and later removed and relaid elsewhere if need be, was considered most economic by the majority of the engineers and water supply heads concerned.

Continuous Quantity Production

Briefly, the new McWane shop meets this demand with a continuous quantity production process, highly mechanized and with many unusual engineering features. Most of the equipment was designed in its own

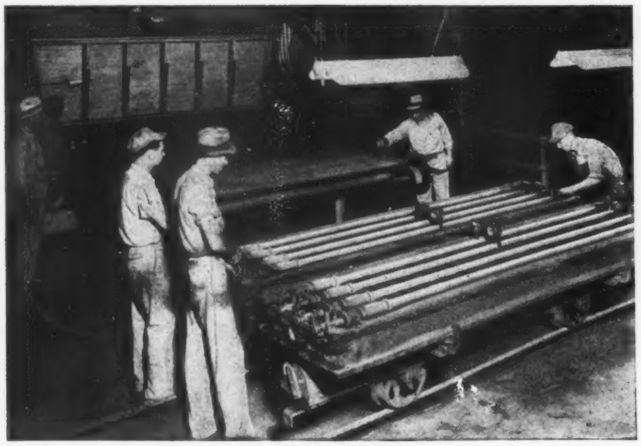


Fig. 1. Setting cores under micrometer gauge control.

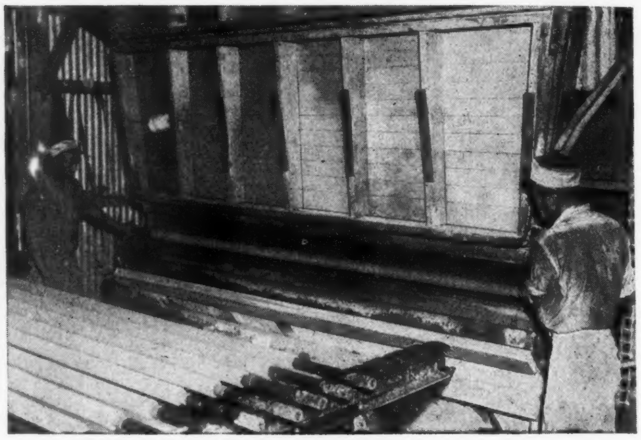


Fig. 2. Core making machine.

engineering department. Though in operation only a few weeks, the new shop is now operating in two daily shifts, and production has been increased by 25 to 30 per cent. Ultimate capacity is now set at approximately 35,000 feet of 2-inch pipe per day.

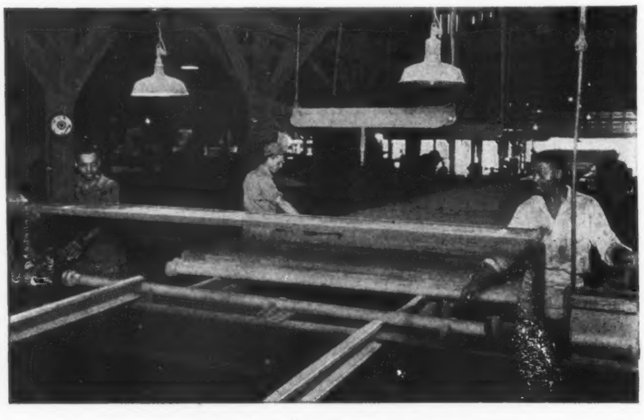
As formerly, all pipe in the new foundry is cast in 9-foot lengths, in green sand molds with green sand cores, and is equipped with various types of joints. The majority of shipments, however, are made in 18-foot laying-lengths—two 9-foot pipes joined with 2½-inch oversized male and female threads intermediately.

The basis of the new manufacturing method is a double-track railway system running from end to end of the shop, in front of the various sand-slinger, core-making, and other equipment. Along this trackage move the flasks and molds, cores, to meet the iron; with the pipe emerging at the far end of the return journey on the outer track.

First the empty flasks for the molds begin traveling on their cars down the right-hand track of the production line. Four half flasks are placed on each car. Two cope flasks are set on top of two drag flasks in the initial stage. (The "cope" is the top half of the pipe mold; the "drag" the bottom.)

At the first "station" on the railway an air hoist shifts drag flasks from the casting car to an electrically driven molding car. The top of this molding car is a unique multiple-plate pipe pattern which simultaneously molds four pipe to each flask.

This pipe plate pattern is removable and interchangeable, permitting any one of several different styles of joints to be made on the same machine.



Hydrostatic testing of 2-inch pipe.

Next, the molding car travels to the sand slinger machine, under which it moves back and forth while the flasks are being filled. Here another manufacturing innovation is seen. Where formerly the molds were laboriously rammed by hand or with pneumatic tampers, the new machine takes the especially blended and treated sand from the machine's bin and hurls this sand into the traveling pipe flask below with such force that it is quickly and uniformly impacted for the entire length of the flask.

Here the flasks "change cars" by air hoist, to hurry on to the core-making machine.

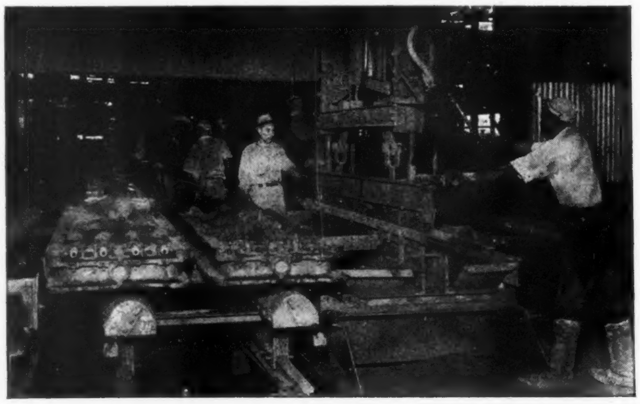


Fig. 5. Gate breaking machine shearing off pouring gates.

Core Making

As shown in Fig. 2, the core-making machine retains the original McWane principle of a sheet of sand falling upon the length of a whirling wetted steel core bar, with such force as to pack the sand hard against it. A core knife then removes all excess sand beyond the correct core diameter, and a gas flame dries the cores.

Core Setting

Setting the cores in the drags of the flasks is one of the most delicate and meticulously handled operations in the whole pipe-making process. For with horizontal casting in lengths as long as 9 feet in a diameter as small as 2 inches cores must neither sag nor float at pouring time. To attain this absolute uniformity of pipe wall micrometer gauges (See Fig. 1) are used to indicate correct core settings to a

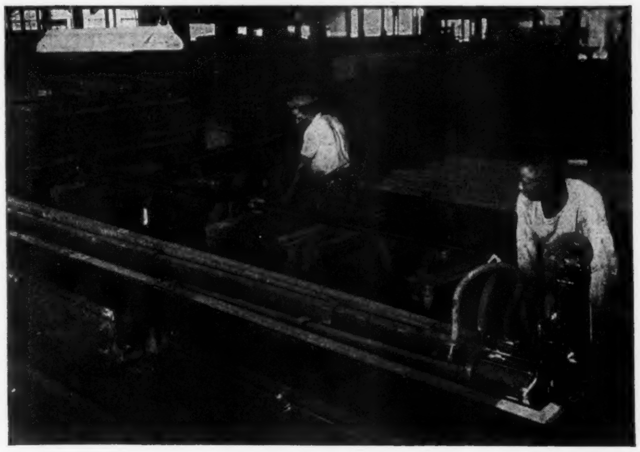


Fig. 3. Assembling pipe in 18' lengths and air testing for 90 lb. pressure under water.

Fig. 4. Sand slinger machine loading pipe flask.

hair's breadth. And this without slowing the pace at which the whole integrated process of pipe casting must constantly move.

The Cope

The casting car now moves on to the cope machine where a duplication of the initial molding machine operation occurs. Here two molding cars alternately operate under the sand slinging machine. The only difference is that five pouring sprues or spouts are provided in the flasks for each set of two pipe. It is through these sprues that the molten iron is poured.

Pouring

The completed flask next moves on to receive the iron, where further innovations appear. In the McWane process the molds travel to the iron, not the reverse as in older shops. Further, the iron is poured from multiple-lip ladles, the sprues or spouts of which are arranged very much like the spout of a coffee pot. In other words, the molten iron is poured from the bottom of the ladle, not from the top. The reason for this is that any dross or impurities in the iron always rise to the top. In these ladles the run-off is from below that zone, insuring only the best and cleanest of the iron reaching the pipe flasks.

This type of ladle also insures the iron reaching its final destination in the molds in the shortest possible time. The temperature of the iron is also checked during the pouring by means of an optical pyrometer, as shown in Fig. 6. Nothing is left to opinion or guesswork here.

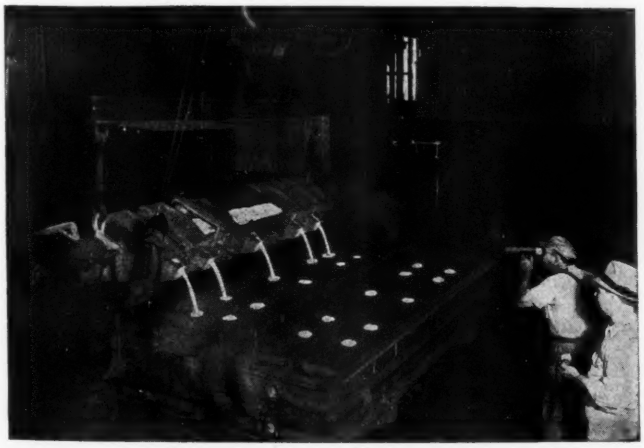


Fig. 6. Pouring iron into pipe flasks under optical pyrometer control.

Final Operations

After the flasks have been filled with iron the casting car goes on to the shake-out machines, where the clamps are removed from the flasks, the copes are lifted by air hoists, and placed on a vibrator shake-out machine of especial design. Then they are placed on top of the drags of the preceding cars. Here begin the first operations of repeating the cycle, as the car is now ready to return to the starting end of the production line.

Air-powered hooks lift each two pipe from the drag and place them in the "gate breaker," an ingenious machine that shears off the "gates" left where the iron entered the molds. Then the pipe is slid along parallel rails to a vibrating machine where the cores are withdrawn.

After the pipe have been taken from the drags all loose sand, gates, and small particles of iron are cleaned from drag and car. The car with its burden of two drags is then lifted with an air hoist and transferred to the inbound track of the production line. All sand and iron gates fall into the shake-out pit on a tilted steel apron that moves the mass forwared by vibration.

During this operation the iron is separated from the sand, and each recovered for reuse in cupola and sand slinger. The sand however undergoes exhaustive reconditioning first by screening, adding fresh sand and moisture, mulling, and aerating. All of this is accomplished in a mixing or blending apparatus, after which the finished sand, as good as new once more, is carried by conveyor system to storage hoppers for further cooling and tempering before its return to the sand slinger machines.

In a very sketchy manner the foregoing outlines the essential steps in this new mechanical production of McWane 2-inch cast iron pipe. Space prevents detailed description of the testing, inspecting, and watchfulness which goes on at every stage of the process.

Final steps in this include the 48-hour period in which each pipe is cleaned, inspected for straightness, given a 500-lb. hydrostatic test, dipped, cement lined if specified, given threaded or precalked joints, assembled into 18-foot lengths, and given a final air test under water of pipe and intermediate joint, before it is adjudged ready for shipment.

Control of Underground Water — A Discussion of Subdrainage Practice

By M. J. ADAMS

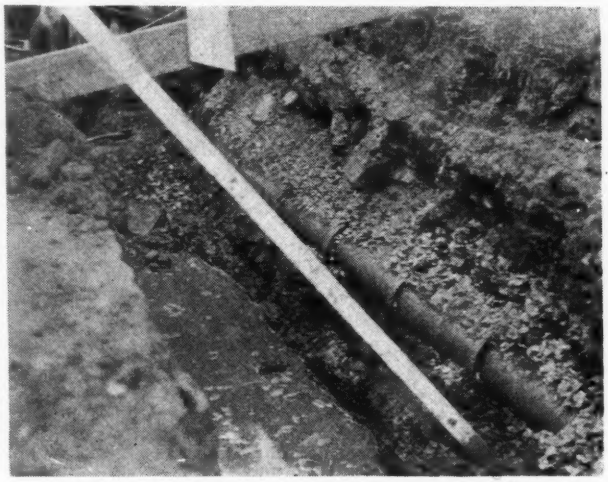
Conclusion of an Article That Appeared in the November Issue

Location of Subdrainage Pipe Above Bottom of Trench

Subdrainage in highway work should not be copied from methods used in land drainage; the ends sought are very different. In many cases land drainage methods have been used in attempts at engineering subdrainage, but they have not been successful.

Normally, subdrainage will be installed only where there is a heavy soil and considerable quantities of ground water. If the subdrainage pipe is to be laid in a mucky trench and if the bulk of the ground water is to be taken in through the lower part of the drain joint, then the pipe must be raised up out of the muck and the muck must be kept away from the pipe by means of a pervious backfill, or mat, under the pipe.

Elsewhere we discuss the tendencies and standards regarding size of particle of pervious material. It is only necessary here to say that in numerous cases of the drains inspected and reported on, the particle size of the pervious material used was much too large. A large particle size means large interstices, which make it relatively difficult to keep the wet, mucky material in the bottom of the trench away from the invert of the pipe. The idea that large particles with large interstices are necessary in order that the ground water could readily reach the subdrainage pipe was so generally held that the worst cases tended to fix the limits and over a period of time the use of 5-inch and 6-inch thickness of relatively coarse, pervious material became the standard thickness used under subdrainage pipe.

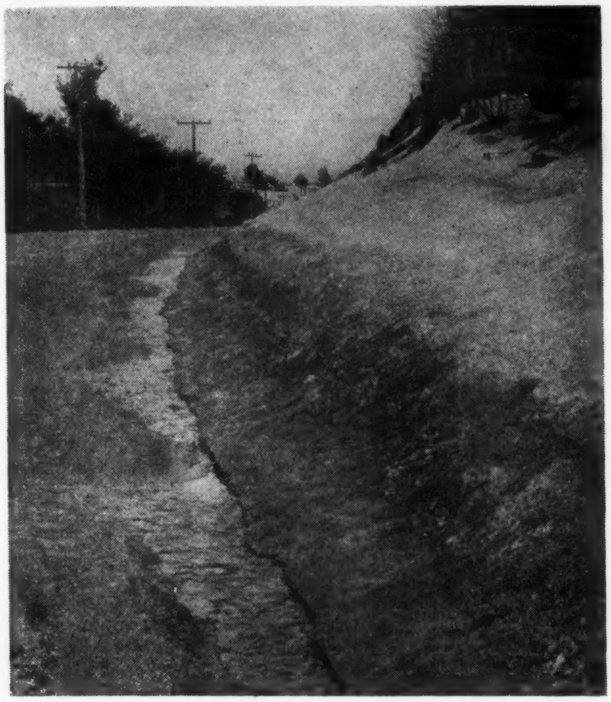


Pavement not protected by pipe 3' 6" deep, the principal source of ground water being 7" or 8" below the pipe.

A "combined system" carrier with perforations at top of pipe, the sides packed with impervious material up to just below the perforations. Primary function to carry surface water from catch-basins; secondary, to control underground water.

During the recent investigation by means of inspection holes dug to check on the behavior of subdrains, numerous cases were found where the water in the bottom of the subdrain trench was standing some inches above the flow line of the pipe. In other cases on newer work and on steeper grades, there was a strong flow through the pervious material below the pipe. In a considerable number of cases of wet trench, there apparently had never been any flow in the drain pipe. This means there was a depth of water of six inches below the bottom of the pipe, plus, in some cases, from 3 to 4 inches additional depth, up the sides of the pipe. Assuming a trench width of 2 feet and 40% voids, computation (2'x0.67x1'x0.4') shows about 4 gallons of water per lineal foot of drain. This is the amount of water which is not picked up by the pipe and therefore cannot be controlled.

This brings us to another question: Why put a pipe in any way? Would not the flow through the pervious backfill be sufficient and satisfactory? Such a treatment would be satisfactory only if you were working in soils which did not require subdrainage. Most of the cases with which you are concerned have a sloping water table, with the natural movement of the underground water across the highway, and you attempt to stop the cross flow by digging a trench on the upper side and filling it with pervious material to cut the flow. If the water is not now picked up and moved quickly, under control, to a safe outlet, but is given an opportunity to soak into the soil on the pavement side



A high back slope, particularly on the south side of the road, means accumulation of snow and ice.

of the subdrain trench, you may jeopardize the entire investment you are making.

To go back to our example given above. Think what it means to have 4 gallons of water per lineal foot standing in the trench. Some portion of this is bound to soak into the pavement side of the trench. If the engineering investment which you are seeking to protect is worth the expense of a deep trench filled with pervious material, it will be worth a trench filled with pervious material plus a pipe. And may I add further that the pipe and the method of construction should be such as to give the maximum degree of control over the contained water.

I have seen examples of the use of a trench filled with pervious material, but without a pipe, and they were not satisfactory. The outstanding example was a section of road built in the fall of 1939, with a continuous sidedrain for the full length of the work on the high side, but with no pipe in it. This pavement broke up so badly the first winter that it had to be rebuilt the following year. The cost of the pavement as well as that of the subdrain had been wasted. A moderate increase in the original expenditure would have protected the whole investment.

Elsewhere, in discussing "Particle Size, Pervious Backfill," we show that ½-inch stone is as satisfactory as larger size for drainage; and it evidently would serve much better as a blotter, and therefore a much less thickness of it will serve to keep the pipe out of the muck and the muck out of the pipe. It is possible that a 2-inch thickness of this small stone may be better than a 6-inch thickness of large stone. If so, then we have made a material advance in our efforts to control underground water.

Perforations Up or Down

In 1926 the Armco Culvert Manufacturers Association made a series of tests at Middletown, Ohio, to determine the proper design and proper way to use perforated metal pipe. As outlined in the report, the primary purposes of the tests were to determine:

1. The proper location and size of the perforations to best prevent the admission of solids into the pipe.
2. The location and size of perforations, considering both the maximum discharge of water and the minimum inflow of solids.
3. The efficiency of perforated corrugated metal pipe for drainage purposes.

The pervious backfill placed around and over the pipe to be tested was sand; all pipe tested were 8" in diameter; two sizes of perforations and several numbers of rows of perforations were used; and pipes were tested with the perforations on the bottom, on the sides and on the top.

The test results indicated that, from the point of view of both hydraulic efficiency and the admission of solids, the pipe with perforations down was to be preferred. It was noted that, with the perforations in the bottom, the ground water bubbling into the pipe kept the silt that entered it stirred up and it was carried on and out by the flowing water. Therefore, perforated pipe was recommended for use with the perforations down.

In those early years, one of the widest uses of such pipe was in airports, which had a fairly level water table. The problem was to lower and control the water table by means of subdrainage. For this purpose, perforated pipe with the perforations placed down was logical and proved satisfactory.

As experience broadened it was seen that for some uses the perforations should be placed up and not down. One of the most obvious was in the case of bank drainage. Assume that a soil survey was made by means of inspection holes, and an attempt made to so

With conditions shown in the illustration above, thawing and freezing causes ice hazards and erosion and softening of pavement and shoulders.

locate the pipe line as to have it always in impervious material. It would sometimes happen that between inspection holes the soil would change to a more pervious type and the water already picked up by the pipe would drain out through the perforations in the bottom of the pipe.

Another case would be where a bank drain was on a steep gradient. With the perforations down, the collected water was likely to get out of control and wash out the trench. Also, in the case of highway subdrains, it was found that, because of frequent changes in the character of the soil, the drain was sometimes picking up water in one area and letting it out somewhere else. In one case in New England, when investigating a badly heaved pavement, we dug ten or twelve inspec-

tion holes in a distance of about 800 feet, and it is almost true to say that no two of them were alike—they varied all the way from a 10-ft. depth of clay silt to holes which showed nothing but a coarse sand.

You might well ask, what does it matter if the water picked up in the impervious material is turned loose in the pervious material? The answer is that, if you do turn it loose, it will be likely to turn up somewhere else to plague you, for you have lost the opportunity to control it. Further investigation of the case mentioned above showed that if water picked up in the impervious material is turned loose in the pervious material, it could not get away because of a complete impervious blanket on the down hill side of the pavement.

Loss of control of collected water may result from carelessness in excavating the subdrain trench, cutting it in places many inches too deep, and then filling the sag with pervious material, resulting in a water pocket, water which cannot be picked up and cannot be controlled.

The first step toward controlling such problems was to point them out and to recommend that at these places the pipe be placed with the perforations up. Unperforated pipe was also used in special situations. In the meantime, with wider experience, we came to realize more and more that in most cases of subdrainage in this area, our problem was a matter of control of underground water, of picking it up and keeping it in the pipe under control, and conducting it to a safe outlet. And we now believe that the perforations should be placed up in many, if not most, cases.

Note, however, the precautions that should be taken when a subdrain is constructed with the perforations up. The pipe line must be placed somewhat deeper, so that the perforations in the top of the pipe are below the water bearing strata. This does not necessarily mean a considerable additional expense, for no pervious material is needed under the pipe.

With perforations down, pervious backfill is required under the pipe and entirely around the pipe out to the sides of the trench. With perforations up, no pervious material is required under the pipe, but the sides of the pipe are packed with impervious material (usually the native material from the side of the trench) up to within about an inch of the lowest rows of perforations, and this impervious material is sloped upward from there to the sides of the trench; so that in this manner the amount of water which is not controlled is very small. A small-sized particle is recommended for pervious backfill, for this gives the sides of the trench much better support and will greatly reduce the amount of solids brought in by the ground water. (See further discussion under heading "Particle Size, Pervious Backfill.")

Under what conditions, then, should perforations be placed down? If run-of-bank gravel is to be used for the pervious backfill, it would not be wise to place the perforations up unless a considerable thickness of small size stone is placed between the top of the pipe and unscreened gravel. In the case of relatively long lines of small diameter pipe, particularly on flat grades without occasional basins for de-silting, it would be unwise to place the perforations up. Of course, if this system gets the advantage of flushing action from catch basins, that again changes the complexion of things.

What about level water tables? I begin to wonder if there are any in this section, even in airports. Recently on an airport under construction, the area being nearly level for thousands of feet in all directions, I saw a difference in elevation of water table of

Unstable soil at side of trench is breaking down even while pervious backfill is being placed.

Mud has moved into this trench, dug only an hour before. It would clog a pervious backfill if made with coarse particles.

from 7 to 8 feet in a distance of only about 350 feet.

Where there is a long back slope on a sidehill highway, a subdrain will frequently be required to control the underground water which would otherwise saturate the soil under the pavement and shoulders. It is wise to have at least manholes and sumps at frequent intervals along such subdrains; and if these manholes are made catch basins, it will only call for a moderate increase in pipe size and the subdrain pipe with perforations up can serve a dual purpose, controlling both surface water and underground water to a safe outlet. Such a dual purpose drain is a great help during the winter and early spring, when the water from melting snow and ice on the shoulder and in the gutter frequently causes hazardous ice conditions, and softens the shoulder and pavement foundations.

To sum up as to perforations up or down, there is no hard and fast rule; from a beginning of always placing the perforations down, we now believe that there are a large number of cases where the perforations should be placed up.

If the decision is to place the perforations up, you must follow through and see that no effort is made to combine old principles and new principles. Do not place pervious material under the pipe or around it below the lowest rows of perforations. Put the pipe on the bottom of the trench and pack around it and up close to the lowest rows (of perforations) with impervious material.

Particle Size of Pervious Backfill

In the subdrainage here under discussion we are then dealing with a wet, relatively impervious soil, clay, silt, or hardpan. We have to dig a trench at least 4 feet deep and maintain it while we are placing pipe and pervious backfill. With the drain pipe in, the trench is backfilled. If a pervious material is used with a particle size as big as your fist, there are relatively large interstices, which leave considerable areas of the side of the trench unsupported, and the next time the

Four-lane concrete pavement with combined drainage. Drain back of right curb prevents water from wet bank flowing onto pavement.

underground flow starts into the subdrain trench, those portions of the side of the trench that are unsupported by the stone backfill become softened and flow into the interstices of the stone fill.

The value and life of the subdrain is therefore dependent upon the stone size, as well as on the character and wetness of the native soil in the sides of the trench and on the efficiency with which the pipe and pervious backfill are working together to carry away the water and silt. And of these factors the size of the stone is perhaps most important. The use of large stone may result in a short useful life for the subdrain. Under some conditions the poor support they provide for the side of the trench, particularly when combined with a strong flow of water, may cause the movement of enough material to cause a serious breaking down of the sides of the trench.

In certain cases this type of failure has been so serious that some engineers are advocating a complete vertical layer of coarse sand or grits between the side of the trench and the coarser pervious backfill. While there may be cases where this treatment is necessary, in the great majority of cases it is believed that a pervious backfill all of which will pass through a ¾-inch screen, 80% between ¼-inch and ½-inch, and all retained on #10 sieve, will serve satisfactorily.

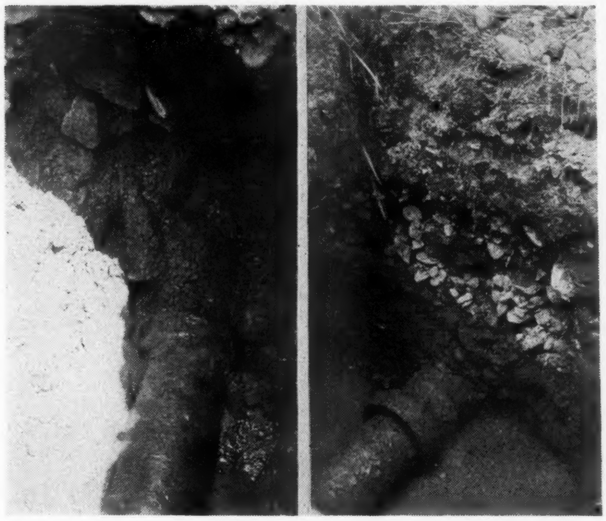
For those areas where clean, sandy, run-of-bank gravel is available at moderate expense, that is the thing to use. However, I have had the experience of learning how greatly ideas can differ on what constitutes clean run-of-bank gravel. I wish to emphasize that run-of-bank gravel used for subdrain should be low in fines and practically free of clay or silt.

Depth of Pervious Backfill

Assuming that, by means of inspection holes, a study has been made of soil types, the strata that are most likely to give trouble have been identified, and a decision has been made as to the depth at which to place the pipe, what about the depth of pervious backfill to be placed over the pipe? What is the minimum depth that can be expected to give the greatest drainage benefits? What is the least thickness of non-pervious material that should be interposed between the top of the pervious backfill and the surface?

I have recently observed the behavior of a high-type modern highway on which considerable quantities of water poured from the pavement joints through the spring and into late summer. There was known to be a subdrain in place, so inspection holes were dug to check on conditions. The depth of trench appeared adequate—about 5½ feet. The stone size was larger than desirable, but in itself that did not seem a sufficient answer. But the depth of stone over the top of the pipe was only about 18 inches; above which the trench was filled with the native clay-silt hardpan, and enough ground water was crossing over the trench through this material to render the subdrain inoperative.

In two recent cases, subdrains put in last year were not wholly successful, as there was some surface breakup this last spring. Inspection holes showed a depth of 20 inches of non-pervious backfill over the top of the pervious backfill, and it is believed that this was the reason for the partial failure of these two drains.

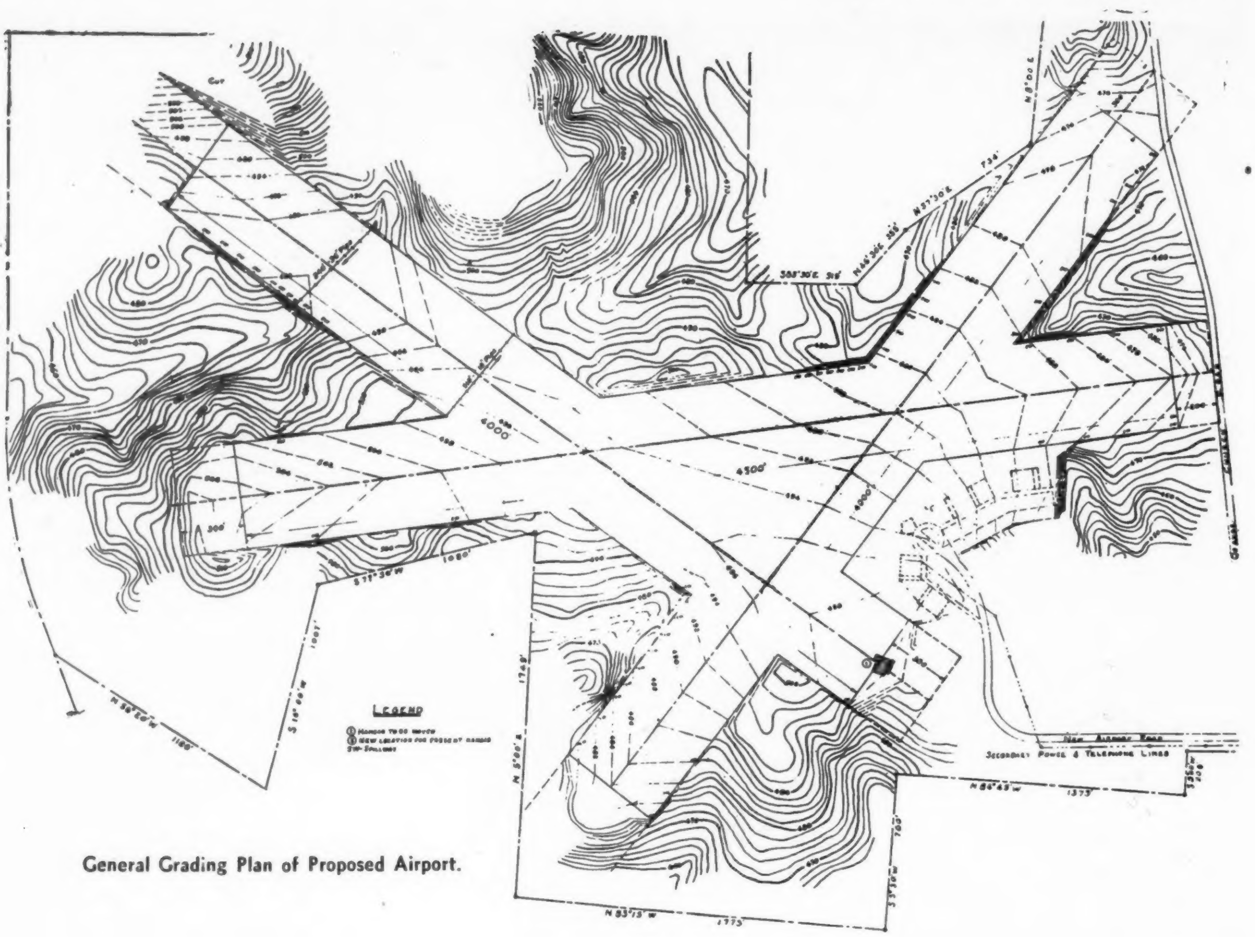


Left—Water standing more than half way up on outside of pipe. Interstices nearly filled with muck. Right—6" pipe with open joints. Silt from the sides of the trench filled the interstices in the 5" to 6" of stone under the pipe and for 8" to 10" above it.

What is the other limit? How close should the pervious backfill be brought to the surface? Certainly the pervious material should not be stopped so far down that considerable quantities of ground water will cross over the trench, through the relatively impervious backfill that is used as a cover. On the other hand, the pervious material in the trench should not usually be brought up so near the surface that your subdrain is

(Continued on page 41)

A back slope 2,000 ft. at the left formerly brought quantities of surface and underground water to this highway; now prevented by combined subdrain under left gutter.



General Grading Plan of Proposed Airport.

Construction of an Airport for a College Training Program

By A. R. HOLLETT

University Engineer, and John Gove, Assistant Engineer of Project

Considerations in selection of the site. Essentials in preparation of the master plan. Construction methods and details.

IN THE spring of 1940 the University of North Carolina sponsored a C.P.T. program under the Civil Aeronautics Administration, making a contract with the owner of an existing field two miles from the campus to give the flight training. This field was limited in facilities and could be used for primary training only; to make it suitable for secondary training would necessitate extensive alterations and purchase of additional land. Since Federal aid, which we expected to obtain, could not be used on a private field, a new and larger site had to be obtained.

The site should, it was decided, have an area sufficient for long-term future requirements of the University's training program and of the community. More important was the fact that the University is only a few minutes by air from one of the world's largest artillery bases, two army air bases, a new marine base, an anti-aircraft base, a very large powder plant, several hydro-electric developments, a coast guard base, an important shipyard and other proposed developments; in view of which and other factors it was decided to follow the specifications for a Class IV Airport as far as practicable.

In selecting the site, the University officials considered the possibility of expansion; obstructions; meteorological conditions; accessibility; topography; soil characteristics; utility services, and cost of land and ease of construction. After studying seven or eight sites, one was obtained containing 600 acres, 450 of which were donated by the late Prof. Horace Williams, for whom the field is named.

Funds were not available to employ consulting engineers, and a civil engineer, working under the University engineer, was employed to supervise the surveying and construction. Purchasing, accounting, etc., were handled through the regular University organization.

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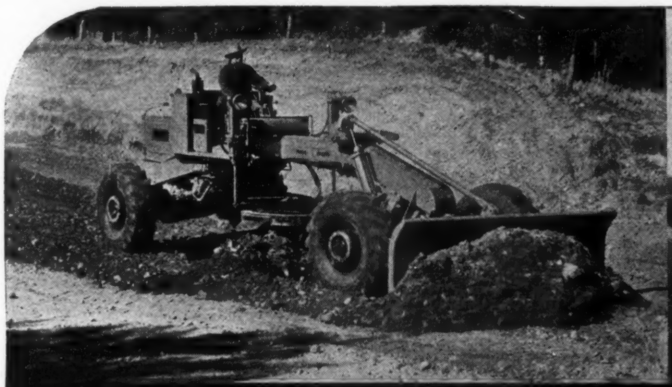

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A master plan was prepared outlining existing facilities, the proposed project and its ultimate development, of which the following were the essentials:

1. A complete property survey.
2. A topographical survey, and a map on a scale of 1" = 200 ft. with 2 ft. contour intervals.
3. Location and obstruction map, including territory within a radius of several miles, showing highways, railroads, and height of obstruction, on a 30 to 1 ratio.
4. Aerial photographs of the area made by the A.A.A., used to study the surrounding territory for possible emergency landing fields, etc.
5. Meterological data. Temperature and precipitation data were obtained at a weather station in Chapel Hill. The wind rose was plotted from official records.
6. Soil survey; identification of surface and subsoil as sand, clay, and clay loam. The soil characteristics were the same as those of the existing field, experience with which gave actual data as to suitability for use in the new landing areas.
7. General layout plan. A careful study was made of the map and wind rose to locate runways that would best suit the topography and prevailing winds; rough profiles were plotted and, with the help of the Regional Airport Engineer, the final locations, grades, lengths of runways, surfacing, building layout and ultimate plans were determined.
8. Drainage was a simple problem, owing to the field location and character of the soil, which drained readily and made subsurface drainage unnecessary, while only two surface drains were necessary.
9. A complete lighting layout was prepared, although funds are not available to include it in present construction.
10. Utilities. Power and telephone lines already existed within a mile of the field. Septic tanks were used for sewage disposal. Water was obtained from several springs located near the buildings, a storage basin being built and an electric automatic pump installed.
11. The field was in a strictly farming area and the University owned sufficient surrounding land to protect the field adequately, so zoning laws were not considered necessary.

An economic balancing of cuts and fills gave us an EW runway of 4800; a NE-SW of 4100; and a NW-SE of 4200 ft. Each can be extended but at considerable cost for grading. A firm turf on well-drained soil will provide virtually a year-round surface for limited traffic; and since use of the field will probably be limited to training and light traffic, paved runways were considered uneconomical.

Only one hangar was considered necessary. In designing this, we bore in mind our experience in January, 1941, when fire destroyed an old hangar, with ten planes, office, and equipment. This hangar was open at one end only and main repairs were done in it—both undesirable features. For had the other end of the hangar been open at least 7 of the planes could have been saved from the fire; and separate shop facilities with a fire wall between them and the main hangar would have prevented the fire.

Construction

Since the University was operating a Civilian Pilot Training Program at the time construction began, the primary consideration was to keep the existing field open until flying operations could be transferred to the new field. The 2000-foot, northeast end of the NE-SW landing strip and the 1800-foot east end of the E-W landing strip were chosen as starting points for three reasons: (1) These two sections of the new airport were as large as and had gentler grades than the entire original airport. (2) They were within economical taxi distance of the original hangar and shops, so that these facilities could be used until the new hangar and shops were relocated. (3) The cuts and fills on these sections were so nearly balanced that the grading equipment need not encroach upon the original landing field to complete usable landing strips.

Excavation.—Before making an excavation estimate, the supervising engineer had test borings made in all of the proposed cuts, which disclosed rock in only three small areas; and the W.P.A. (the constructing agency) made a second survey entirely independent of the first, using the large supply of unskilled labor assigned to this job to dig over two hundred test pits, approximately 4 ft. square, to below finish grade in all cuts. The test pits disclosed granite boulders in the northeast section, solid granite in the northwest section, and a negligible amount of rock elsewhere. It therefore was thought that a power shovel would not be necessary but that four 4-wheel scrapers, 9, 10 and 12 cu. yd., and a bulldozer for stumps would suffice. It was assumed that the test pits had provided a reasonably accurate knowledge of the sub-surface, but after stripping the over-burden, the boulders in the northeast section were found to be so tightly interlocked that only a small percentage could be removed by the bulldozer. They were, however, so loose that a charge of dynamite in one would not loosen or break up any adjoining rock, so removal was effected by the slow, tedious process of drilling, blasting, and clearing away each individual boulder before the next lower boulder could be attacked.

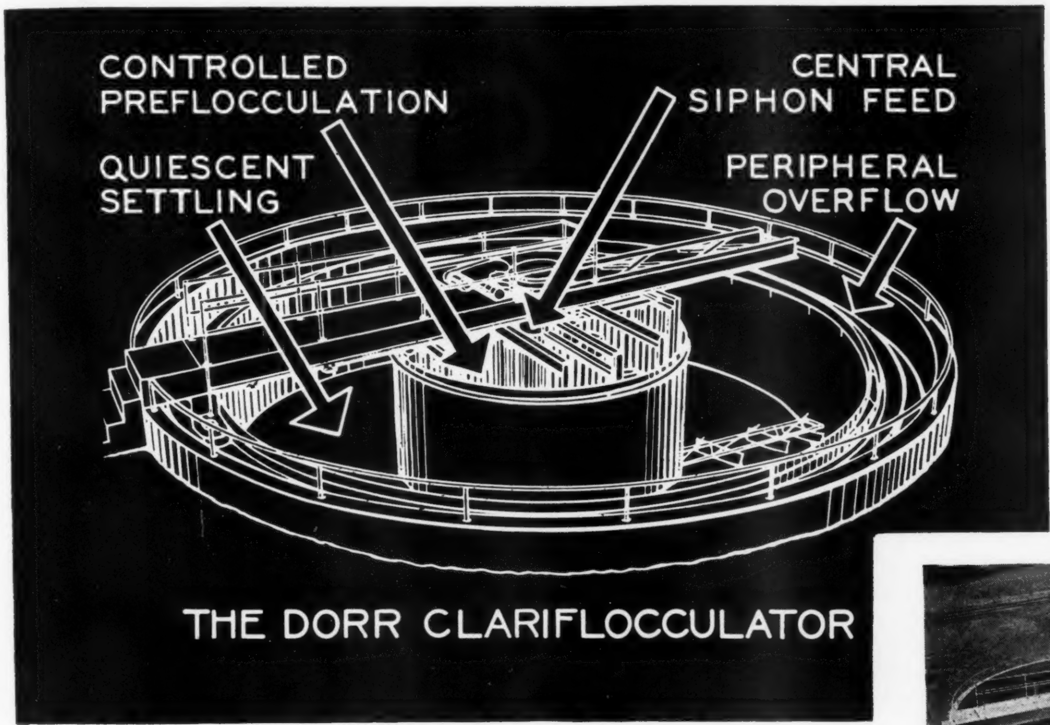
The areas which the test pits had shown to contain a negligible amount of rock proved, after stripping, to have large, irregularly-shaped layers of decomposed granite ranging in thickness from one foot to ten feet. The rock, although soft and "rotten," was still too hard to be moved economically by the four-wheel scrapers, and a 5-ton, tractor-drawn rooter was rented to remove it. Since this tractor had a bulldozer blade and "pusher-plate," it was also used to push the 4-wheel scrapers when not drawing the ripper. The increased production well justified the cost of this unit.

At some points the granite was too hard to be moved economically with this equipment and we used the best available—a ¾ c. y. power shovel and five 1½-ton trucks. We found that, so long as the 4-wheel scrapers could move the material, even though the aid of a ripper and a pusher was necessary, this was 40% cheaper per cu. yd. excavated than use of the shovel and trucks, partly because the shovel was too light for the work. Based on a 3½-month study, the costs have been 18.6 c. (including several thousand cu. yd. of boulders) per cu. yd. for the scrapers and 33.3 c. for the shovel and trucks. We are now using a 1½-yard shovel with three 12-yard Euclids, which should give a much truer comparison of costs.

Fills.—Where fills were made with scrapers, these were so routed as to traverse each 6" to 8" layer at least twice, and supplementary use of sheepsfoot or power rollers were considered unnecessary. After seven months, no settlement has been noticed, even in fills over 18 ft. deep. All fills were capped with 18" of a porous mixture of loam and decomposed granite, to aid drainage. Where necessary, the cuts were covered with the same material.

Before grading was started in any section, the top soil was stripped and stock-piled with scrapers. The rough grading left all grades within about 0.2 ft. of the final elevation and very little fine grading was

BETTER SEDIMENTATION



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necessary before applying the top soil, what was necessary being done by motor graders and road machines. Then the 4-wheel scrapers applied a smooth 2" layer of top soil, which was then fine-graded by the motor graders.

To obtain a strong turf on the landing strips, Bermuda cuttings and roots were set in rows 12" apart, this giving a strong turf earlier and with less care than seeding; also it was more economical, since Orange county has on its farms many acres of Bermuda grass that the farmers willingly gave to the university. This sod prevents erosion by water which, not percolating through the porous soil, runs to the edges of the landing strips, where it is intercepted by a 2 x 4 ft. earth berm which directs the water through open rubble stone spillways. Low-growing honeysuckle vines planted on the fill side slopes prevent erosion by rain that falls directly on these slopes.

Difficulties of Night Work.—In an attempt to complete the rough grading on two landing strips by July 1, 1941, the working day was lengthened from sixteen to twenty-four hours. On this particular job, this resulted in an efficiency loss of at least thirty per cent. Several factors were responsible for this: (1) The lighting (which was about equal to ordinary street lighting) was inadequate for this type of work. The equipment operators could not accurately judge the amount of earth being hauled and, consequently, often carried only partial loads to the fills. Then, too, the areas graded at night had to be reworked in many instances during daylight hours as the operators could not see to carry accurate grades. (2) The equipment actually slowed down for lack of adequate repairs and servicing. On the sixteen-hour-per-day schedule, the equipment operators had eight hours each day in which to clean, grease and oil, adjust and make minor repairs on their machines. On the twenty-four hour schedule, the lack of adequate servicing caused a general slowdown in operating speed, more minor break-downs, and less ease in handling. Also, neglected minor repairs became time-consuming major repairs.

Hangar Construction.—In construction of the hangar only simple equipment and unskilled labor were used. The prefabricated steel frame was set in place with a gin pole and hand winch. All field connections were ⅝" and ¾" machine bolts with lock-washers. Spud wrenches and drift pins were the only tools used by the crew of workers, none of whom had had any prior experience in erecting steel. After the frame was securely bolted together, the sides and roof were covered with 26-gauge corrugated iron sheets bolted directly to the girts and purlins with ¼" stove bolts. Lead washers completely sealed the holes against weather when the bolts were tightened in place. Since each sheet was fastened to the frame by bolts at 6" intervals along every girt and purlin, covering the building made it even stronger and more rigid than originally designed.

The partition wall between the hangar and the shop, and the wall between the hangar and the office section, were built of 4" x 12" x 12" hollow tile, to localize any fire and prevent a repetition of the complete hangar loss of January 11, 1941. Here again unskilled labor was used, and produced a creditable looking and efficient fire wall.

Although no runway or taxi-strip paving was anticipated, it has been found necessary to pour extensive concrete aprons, parking, and warm-up strips. Originally, these parking, and warm-up strips were designed to be of turf, but it has since proven imprac-

(Continued on page 37)

Soil Conservation Helps to Protect Water Supply

With three reservoirs silting up, one alarmingly, a plan for preventing further silting has been adopted.

By AMIEL REICHSTEIN

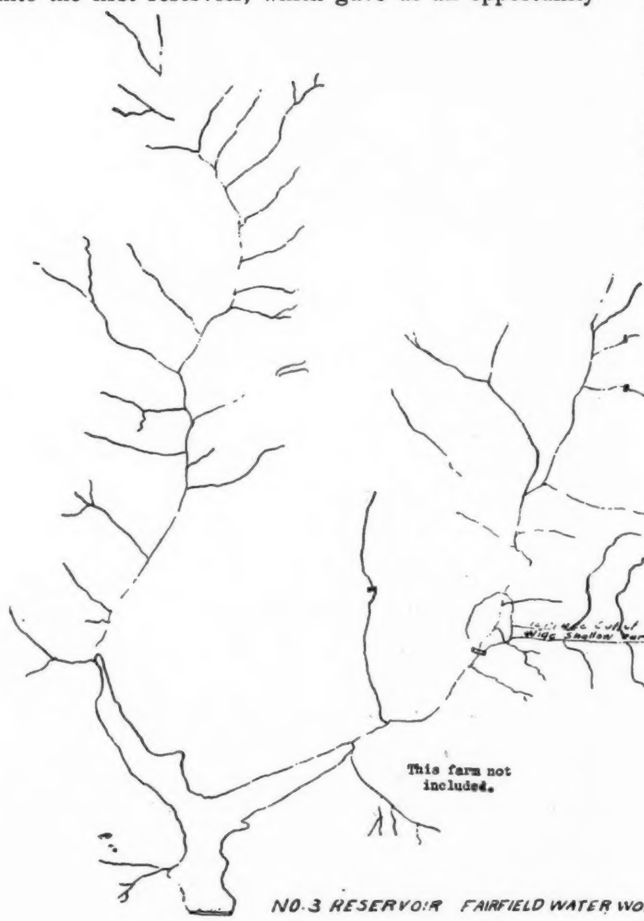
WATER for the City of Fairfield, Iowa, is supplied from three impounding reservoirs. The first one, built in 1884 or 1885, has a watershed area of 256 acres. The second reservoir, with a drainage area of 512 acres, was built in 1900, and the third, draining an area of 2300 acres in 1923 and 1924.

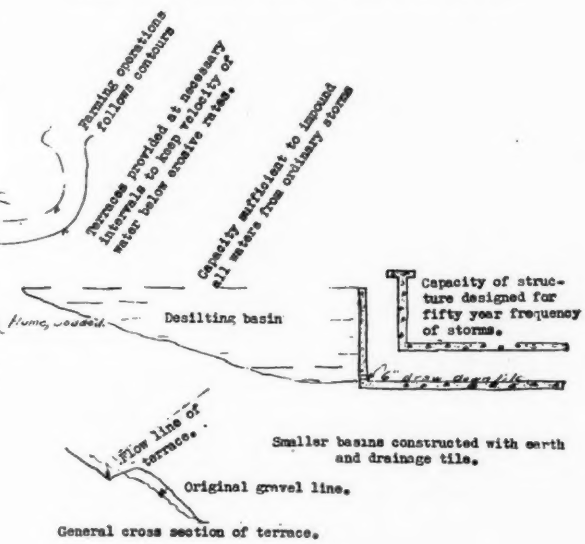
When the first reservoir was built it had a storage capacity of 60 million gallons. The second one had a storage capacity of 120 million gallons in 1911, after the original dam had been raised to increase the storage capacity. At the time the third reservoir was built, it had a storage capacity of approximately 85 million gallons; making a total storage capacity of 265 million gallons, assuming each reservoir has maintained its original capacity.

The question had often been raised as to how much the storage capacity of the reservoirs was being diminished due to the silt that was being carried in from the drainage areas. During the drought of 1934 all of the water from the second reservoir was drained into the first reservoir, which gave us an opportunity to make a survey of the former to determine how much of its capacity had been lost during the period from 1911 to 1934. Care was taken to make the survey accurate. It was found that the reservoir still had a capacity of 103 million gallons, showing a loss of storage capacity of 15 per cent in 23 years. Approximately 200 acres of the 512 acres draining into this reservoir are under cultivation.

A survey was made of both the other reservoirs also, but as there was approximately 20 million gallons of water in each of them, it was not possible to survey them accurately. However, an exact survey was made over the area from the water level up to the over-flow level on each of them, and soundings were taken from the water level to their bottoms. It was found that the first reservoir had silted up very little, as from our figures it appeared still to have a storage capacity of between 55 and 57 million gallons. We had the original cross sections of this reservoir and checked the new cross section with the original records. Except for a short distance out from where the water edge would be with the reservoir full, we found most of the elevations within 6 ins. of the original ones for a distance of 200 ft. from the dam.

On the third reservoir the results were less satisfactory. In 1934 we surveyed it and found that its capacity had decreased from 85 to approximately 68 million gallons having lost 20% of its capacity in 10 years. No surveys have been made since 1934 to determine if the rate of silting has increased but from





Map of Third Reservoir and details of structures.

visual observation it is evident that it has increased considerably and that unless something is done to retard the rate at which the reservoir is silting up, it will not be many years until it will be of little value as a storage reservoir.

A soil conservation camp was located at Fairfield and an effort was made by the superintendent of the camp and the city officials to get the farmers owning the land in this drainage area to cooperate with the city water department and the Soil Conservation Service in building the structures necessary to control the erosion in this area.

To carry out this work would have required the expenditure of some money on the part of the farmers, and when they were approached they seemed to think that the city was trying to get them to help finance something which the city was going to derive most of the benefit from, and so the matter was dropped.

As the area draining into Number one reservoir was much smaller, the Superintendent of the S.C.S. camp suggested that we see what we could do in setting up a project on this area. Most of the land under cultivation in this area is owned by one farmer, and we found him very willing to enter into an agreement for a demonstration project.

This project was carried out and after one crop had been raised on the land we were able to get a large number of the farmers in the drainage area of No. 3 to enter into an agreement with the S.C.S. and the city to do the work and build the necessary structures on their farms to provide the soil conservation and erosion control that was required. The work consisted of building terraces, planting trees, and building structures to create desilting basins. The cross-sections of the terraces are such that they interfere very little with the cultivation of the land. The alignment of the terraces was laid out so that the flow line of each crosses a 3-inch interval between countours every fifty feet, which makes the terraces follow very closely to the contour lines.

The terraces are spaced so as to keep the velocity of the water at such a rate that no erosion of the soil will occur. The discharge from the terraces flows into a wide, shallow, sodded, earth flume, which provides an outlet for all the terraces that can be sloped to that flume. These flumes, in turn, discharge into a desilting basin.

The desilting basins are small impounding reservoirs created by building earth dams across the ravines and smaller creeks; spillways being built into the dams. The spillways for the larger dams were built as drop intake box culverts, and for the smaller ones a line of sewer pipe was laid through the dams with the inlet end at the elevation desired for the overflow from the basin. The capacity of each desilting basin was proportioned so the velocity of the water flowing through it would be slow enough to allow the silt to settle out. The spillways from these basins were designed for storms of fifty-year frequency. Near the bottom of each dam a small tile was laid through the dams to allow the water impounded during a storm to be discharged from the basins at a slow rate.

Where terraces are built, it becomes necessary to follow the countour in cultivating the land and this was one of the main features to which the farmers objected when this plan of soil conservation was presented to them. The run-off from this drainage area

for a given rainfall has been reduced a very noticeable amount by the effect of this erosion control work.

It is estimated from the information that has been collected that the useful life of reservoir No. 3 would have been increased by fifty years if all the work required on the drainage area could have been completed; but the work that has been completed should add from twenty-five to thirty years to its service life.

Careful Planning and Training of WPA Workers

(Continued from page 20)

highway use, so designed as to utilize to the best advantage the labor and material available. Most of the material was obtained from an old 2-story brick theatre building which was bought for $530 taxes and demolished by WPA labor, and the salvaged materials hauled to a site for the office building purchased for $55. A close study of the available materials was made before demolition began and the building designed with the thought of utilizing every piece possible. All the bricks were cleaned and enough furnished by the old structure to construct the new building, with a surplus for use in ditch checks and similar structures.

The demolished building contained 250 2" x 3" joists 24 ft. long, and the new office building was made 24' x 54' and designed to use the full length of these joists. The garage is 48' x 74', being roofed with a timber truss using these 24' joists. Incidentally, these trusses were designed to carry a 2,000 lb. load on rails attached at the quarter points. All the old steel lintels and angles were used, and the large plate glass windows were cut into panes to fit the modern steel sash used throughout the new structure. Around these windows were placed the Bedford stone copings from the old building, which, after being cleaned, added greatly to the appearance of the building. A sign over the front door of the office was constructed from precast blocks poured by WPA.

The interiors are plywood panels finished in a natural shade. The floors were laid with maple flooring taken from the old building, sanded and finished to blend with the walls. There is fluorescent lighting throughout, and automatic steam heat in both buildings. There are bathrooms upstairs and down. The furniture was constructed by NYA, the only costs to the county being for material.

This brick building of modern design houses the offices and drafting room of the county superintendent of highways downstairs and the county offices of the WPA upstairs, with a large garage and workshop in the rear.

The coordination program has proved so satisfactory to the county board of supervisors that they have authorized the purchase of another motor patrol and bulldozer for use on this work, and future construction is planned along similar lines. An unexpected corollary of this coordination program was the training of WPA labor, giving the men a varied experience and more confidence when applying for private employment. This was quite noticeable in the special crew selected to construct the drainage structures and the 3-span bridge, all of the original workers on this crew having left for employment in private industry by the time the last concrete had been poured in the bridge.

During this work A. P. Rosche was county superintendent and the author was county engineer.

What Do You Know About Sanitary and Public Health Engineering?

One of the hits at the last A.P.H.A. convention was the following quiz patterned after the popular radio feature, "Take it or Leave it." Check your own answers against the official replies which appear on another page.

AT THE dinner of the Engineering Section of the American Public Health Association, held at Atlantic City, N. J., in mid-October, a feature was the "Quiz Program" prepared by various members of the Engineering group, aided and abetted by Mr. Orchard and Mr. Scarlett of Wallace & Tiernan Co. The questions, which were grouped under appropriate heads, are reproduced here. Put down your answers before you read the official replies which are given on page 42 of this issue.

I. *Questions on Water Purification.*

1. Name a coagulant used in water purification.
2. Name another coagulant.
3. Name a third coagulant.
4. Name a fourth coagulant.
5. Name still another coagulant.
6. At the meeting on Oct. 14, what did the Committee on Water Supply recommend with respect to open reservoirs floating on the distribution system?
7. Though it is subject to controversy, what is the generally accepted rate in gallons per acre per day for rapid sand filtration at water works plants in the U. S. A.?
8. Name the chemical most commonly used for water sterilization?

II. *Sewage Disposal.*

1. The name of what German Engineer is most commonly associated with sewage disposal in the U. S. A.?
2. What municipal sewage plant in U. S. A. operates a navy?
3. What U. S. A. municipality using activated sludge treatment of sewage treats the largest daily volume?
4. Name any city in the U. S. that sells *heat*-dried activated sludge for fertilizer?
5. What is Leptomitis?
6. What was the theme subject of the Report of the Committee on Sewage Disposal at this convention?
7. What is the principal constituent of sludge digester tank gas?

III. *Chemistry.*

1. What is the atomic weight of chlorine?
2. What is the valence of chlorine?
3. What is the commonest compound of chlorine?
4. What is the chemical formula for Water Works Alum?
5. How does activated carbon deodorize?
6. How does activated carbon dechlorinate?
7. What is the difference between temporary and permanent hardness of water?
8. What is the chemical formula for monochloramine?

IV. *Bacteriology.*

1. Give another name for Bacteria?
2. What is the most common method of rendering drinking water free from harmful bacteria?
3. The presumptive test used in water analysis is based on the fermentation of what sugar?
4. A certain bacterium divides in half every fifteen minutes. One such creature is placed in a 3 gallon water pail. After 24 hours the pail is full of bacteria. When was the pail ¼ full?
5. According to the American Society of Bacteriologists, what is the correct name of B. Coli? Spell it.
6. What is a bacteriophage?
7. Who was Fracastorius?
8. Name the *bacterial* disease associated with the names of the following men: 1. Eberth; 2. Schaudin; 3. Loeffler; 4. Pasteur; 5. Neisser; 6. Koch; 7. Erlich?

V. *Well Known Men Currently in Public Health.*

1. What well known General Manager of a large manufacturing firm making chlorinators, was formerly an Assistant Sanitary Engineer in New Jersey?
2. Name one of two well known engineers who became President of the A.P.H. Assoc.?
3. What is the name of the former United States Public Health Service Engineer who is now a Deputy Health Commissioner of the largest city in the Western Hemisphere?
4. What is the name of the vice-president of a trade paper devoted to Public Works, who became a Colonel in the Sanitary Corps?
5. Name the most recent Chairman of the Public Health Engineering Section, who was an engineer with the U.S.P.H.S.
6. What is the full name of the Chairman of the P.H.E. Section for next year?
7. What is the name of the former engineer employed by the Virginia State Dept. of Health who is now Editor of a well known trade paper devoted to the Water Works and Sewage Works Field?

VI. *Chlorination.*

1. True or False? According to Federal Law, chlorine is classified as a food.
2. True or False? On dissolving in water, chlorine gas follows Henry's Law which states in effect that the solubility of a gas in a liquid is a function of the partial pressure exerted by the gas on the liquid.
3. The Interstate Commerce Commission regulates the interstate transportation of hazardous articles. Under its regulations is Liquid Chlorine classified as: a. A corrosive liquid? b. A compressed gas? c. A poisonous substance? d. An oxidizing material? e. An explosive?
4. Chlorine combined with an alkali to form a hypochlorite is widely used in gymnasium, swimming pool, and locker room footbaths to aid in controlling the spread of Athlete's Foot. The present day accepted minimum concentration of available chlo-

rine in such footbaths is: a. 8,000 parts per million? b. 2,000 parts per million? c. 5,000 parts per million? d. 3,000 parts per million?

5. We hear a great deal today about adequate supplies of chlorine for public health. The estimated yearly chlorine and chlorine compound tonnage used for water purification, swimming pool sanitation and sewage disposal in the United States is: a. Between 10,000 and 20,000 tons. b. Between 20,000 and 30,000 tons. c. Between 30,000 and 40,000 tons.

6. True or False? In a well-operated filter plant, post chlorination may be depended upon to destroy all pathogenic organisms which may have survived prior treatment.

7. Who first used chlorine gas for water sterilization in the United States? Where and when?

8. Is this true or false? During this emergency the Army and Navy are acquiring chlorine reserves to be used as military gas in case gas warfare is commenced.

VII. *Famous Names in Public Health. Who was each of the following:*

1. Sir Alex Houston.
2. Walter Reid.
3. General Gorgas.
4. William T. Sedgwick.
5. Hugh S. Cumming.
6. Louis Pasteur.
7. Dr. John Snow.
8. Robert Koch.

VIII. *Define Public Health Engineering Terms.*

1. Hydraulic Gradient.
2. Anopholes.
3. Chloramine.
4. Coagulation.
5. Effective Size.
6. Cross Connection.
7. Residuals.
8. Presumptive.

IX. *Fields of Public Health Engineering Activity and Their Purpose.*

1. Name 10 fields of Public Health Engineering activity.

Construction of an Airport

(Continued from page 32)

tical to attempt to keep turf in these areas, due to the concentrated blasting action of the propellers and the abnormal heavy traffic near the hangar.

Hand Labor.—Other than the obviously necessary equipment operators, supervisors, and engineers, a large amount of hand labor was profitably used in constructing this airport to clear and grub 300 acres of woodland prior to grading operations, build the hangar and aprons, lay water lines and culverts, build stone spillways, spread fertilizer, dig up and then replant Bermuda grass cuttings, and construct side-slopes on cuts and fills. Since a certain percentage of the W.P.A. grant had to be spent on relief labor, a successful effort was made to utilize this potential power instead of regarding it as a necessary evil.

All equipment has been rented on an hourly rather than a production basis. It was felt that a good grade superintendent could obtain adequate production as well as have more flexibility in the use of the equipment on the project by renting it on this basis and the unit costs have justified our decision.

Priorities for Water Works and How to Get Them

"How can I get the materials to keep my plant running"? "Do I need a priority, and if so, how do I get it"?

THESE are questions which are perhaps uppermost in the minds of most waterworks men today. They are not questions that can be answered completely and definitely in a few words for each particular case but it is hoped that this outline will furnish a useful basis of procedure.

The answer to the first question is that you can get all the essential materials to keep your plant in operation by using priorities. The answer to the first part of the seocnd question is "Yes"—you do need priorities. It is essential that you furnish your supplier with a priority on every possible order because without priorities he is unable to replace his stock and very shortly will be unable to fill your needs. It is up to you to help *him* help *you* obtain the material you need promptly. The answer to the last part of this question follows:

To cover purchases for material for plant maintenance, repair and operating supplies and in certain cases small capital expenditures, there is available Preference Rating Order No. P-46 commonly known as the Utilities Maintenance and Repair Order. This Order, which provides for maintenance and repair of water works, sewerage, power, steam and gas systems, was issued by the Office of Production Management (from whom copies may be obtained) in September, 1941, and most of you are doubtless familiar with it at this time. If not, information as to the procedure to be followed may be obtained from the Office of Production Management and also from the American Water Works Association.

Transportation facilities such as street railways, bus lines, etc., are covered in a way similar to the above under order No. P-22.

For emergency breakdowns where new material is needed immediately, there are also available to municipalities higher priority ratings. For example, if your plant should be partially destroyed by fire you must telegraph the Office of Production Management, stating in the telegram full particulars as to the necessity of new material and the suppliers from whom you wish to buy the material. This request must be a telegram and cannot be a letter. The Office of Production Management will act on this request immediately and take steps to issue a high rating to enable you to obtain the needed material. This method is intended for use in extreme emergencis only and should not be used to obtain ordinary operating supplies.

To cover capital expenditures not included under the Maintenance Order, there is available the PD-1 priority application. This application should be used to cover a specific purchase order placed with a particular supplier. After obtaining a blank form from the Office of Production Management, it should be filled out and returned to the Office of Production Management for authentication. They will review the application and if it is approved will stamp the rating on it and return it to you. When the application is returned from the Office of Production Management it should be forwarded immediately to your supplier.

In the event that a major capital addition is to be made to an existing plant, or in the event of the construction of a new plant, a project rating should be

applied for. The project rating known as P-19 Preference Rating Order is a limited blanket rating issued to cover an entire project. The project rating, when granted, is a "P" order bearing a serial number which is issued to the constructing agency, that is, the city or company doing the constructing. This rating may then be extended to all of the suppliers of material for the particular construction, without the necessity of writing individual certificates for each purchase order. In other words, the rating needs to be extended only once to a particular supplier for all of the material which may be ordered from that supplier. The application for such a rating should consist of a lettter fully emphasizing the need for the new construction and setting forth, in a brief engineering report, all details of the proposed construction. The application should be bound into a folder and filed in duplicate with the Project Section of the Office of Production Management, Washington, D. C.

It should be pointed out that, in general, the Office of Production Management will do everything possible to help utilities to obtain necessary materials. They realize the importance of utilities and will always give every possible aid. The only requirement is that the facts must be presented in a clear and understandable manner and any request for priority assistance must be based on actual facts and not just words. When an actual need for material exists and this need, complete with all details, is properly presented, there is little question that the material will not be obtained. The various field offices of the Office of Production Management can be and are very helpful in the matter of advising what information needs to be furnished. It should be remembered, however, that official rulings are issued only in Washington and not by the various field offices.

For all other cases which may not be covered by the above, the standard rule "when in doubt use a PD No. 1" should be remembered. This form is very complete and if used will generally supply the Priorities Division of OPM with sufficient information so that they can issue a priority number.

Explosion in Sewage Pumping Station

An explosion which occurred in a sewage pumping station in East London, South Africa, is described as follows in a paper by the Sewerage Assistant Engineer in that city's Engineering Department, J. A. Chew, in a paper before the South African branch of the Institution of Municipal & County Engineers:

"On August 4, 1939, at one of the very few pumping stations under the control of this department, when switching on a violent explosion took place which lifted the chamber roof and badly injured the attendant. The explosion was eventually traced to the presence of petrol in the sump and it was finally established that the petrol came from the pipe lines which run from the harbour to the Bulk Storage Sites. One of these lines developed a leak and the petrol, seeping through the ground, had come in contact with the bitumen seal on an earthenware I.P. pipe. The bitumen was dissolved by the petrol which found its way into the sewer and then into the Harbour Administration's sump. From there it was pumped into the Municipal Station and the fumes in the sump leaked through the float control into the switch room. The switches were an open type and a spark ignited the fumes."

This is the first instance that has come to our notice of chemical damage done to bituminous jointing material in sewers.

Flow Measurement of Sewage and Sludge

Development of measuring devices, from the weir in 1894 to the Venturi meter, Parshall flume and Kennison nozzle, with indicating, recording and integrating instruments.

By CHAS. G. RICHARDSON

MEASUREMENT of sewage flow began by use of the rectangular weir, this being the only device available in the early days. The Worcester, Mass., weir, installed in 1894, was among the first to be used for sewage. Weirs are still used, particularly in the smaller plants, but are not ideal for this service due to large head loss, limited capacity range, possibility of upstream ponding, and the catching of floating refuse with resulting inaccuracy; and have been largely superseded by other devices.

Of the devices developed, the Venturi meter is by far the most prominent. Its suitability for measuring sewage was visualized by the manufacturers as early as 1898, although the first to be actually used for this purpose was that installed in the Ward Street pumping station of the Boston system in 1903. This consisted of a 48″ Herschel standard Venturi tube with 24″ throat, and a totalizing register with rate-of-flow chart recording attachment. The maximum measuring capacity was 75 mgd. It was discontinued in 1939 after 36 years' operation. Since then an increased demand for Venturi meters has naturally accompanied the great increase in sewage pumping and treatment. The largest size to date for this service are the four huge Venturis, 114″ diameter with 62″ throats, measuring the incoming sewage of the great Southwest Treatment Plant of the Sanitary District of Chicago. Each will measure up to 290 MGD.

A steel plate is considered unsuitable for sewage, Venturi tubes in the large sizes have been made entirely of cast iron sections, or with the inlet and throat portions of such metal and the outlet cone of concrete. It is gratifying to observe the trend away from flat invert tubes which had some following a few years ago. These are considerably more costly, and there is little evidence to support the idea that they tend less to accumulate deposits on the interior.

The Venturi meter is not applicable to all sewage metering problems. For instance, it obviously has to run full at all times, and where no head is available it is necessary to depress the tube in an inverted syphon at relatively high cost and possible difficulty from deposits at the low points. Or the flow range may be too wide for accurate measurement, as when sewage comes from an institution or a small district. Or the sewage may carry debris too large to pass through the throat. So "Mother Necessity," running true to form, has risen to the occasion and now there are reliable meters for open channel installation, among them the Parshall flume and the Kennison nozzle.

When Parshall, in 1928, announced the modification of the Venturi flume, which for so long had baffled investigators, by the addition of a hydraulic jump at the throat, he made a valuable contribution to flow metering. The previous complicated computations were greatly simplified, since only the head near the inlet now need be considered instead of the head at both inlet and throat. The use of a standard recording flow gauge, operated by a single float, was also thus made possible. He did not visualize the use of this flume for sewage, but in 1933 a Parshall flume with a 10 ft. throat was installed for measuring the effluent of the Providence, R. I., sewage plant. This is still by far the largest Parshall flume used for measuring sewage. (For further description, see "Journal of the New England Water Works Ass'n" for March 1934.) In general, the throat width of these flumes installed in sewage plants thus far vary from 6″ to 12″.

In 1933 the Metropolitan District Water Supply Commission of Boston encountered a troublesome problem in measuring the discharge of the sewage of Holden, Mass., into the Worcester system at three points, so that the cost of final treatment and disposal might be apportioned properly. The pipe sizes involved were 10″ and 16″; the flow very low at times; the range of flow large; considerable trash was carried. Venturi tubes seemed unsuitable, since the throat sizes could not be larger than 3″ and 4½″. In December of that year Karl R. Kennison (now chief engineer of the District) read a paper before the Boston Society of Civil Engineers on a "New Type Open-Nozzle for Measurement of Sewage Flow." This device, further developed and standardized by Builders Iron Foundry, is now known as the Kennison Nozzle. It most satisfactorily solved the District's problems, and it is now being increasingly used in sewerage systems and treatment plants. It is extremely simple, easy to install, and requires little attention. There are a half-dozen installations in New England, others in 9 other states and in Brazil.

One is rather amazed in comparing the first sewage measuring installation at Boston to equipment which is now available for flow measurement and control of sewage and sludge. In addition to instruments for connection to Venturi tubes, weirs, flumes and nozzles to indicate, record, and integrate rates of flow, they are: Hydraulic vent cleaners for Venturi tubes. Air relay transmission of pressures from the Venturi tube or other device to the recording instrument. Multiple gauges for activated sludge plants, showing cubic feet of air per gallon of sewage and per cent of return sludge to raw sewage, automatically controlled, plus rates of flow of sewage, sludge and air. Electric transmission of sewage flow to distant instruments, perhaps miles away in the treatment plant. Flow summation of groups of meters with distant transmission to a master dial. Automatic maintenance of sewage suction well level and surgeless pump discharge. Control of sludge level and introduction of chemicals in vacuum filters. Continuous weight totalization and rate-of-flow of belt-conveyed sludge cake.

The measurement of flowing sludge is more difficult than that of sewage, the difficulty increasing with the density. For pump discharge lines under pressure, the Venturi tube is employed, but there must be adequate provision against clogging of vents and pressure piping. Frequently, continuous back-flushing with clear water is necessary, particularly for the heavier sludges. Some engineers prefer to omit the usual an-

nular pressure chambers at inlet and throat to avoid building up of deposits therein, but dependence is thus placed on a single piezometer vent at each point, which may become fouled or affected by even a small nearby deposit, with resulting inaccuracy of measurement. The wise provision seems to be the retention of the annular chambers and continuous backflushing. For sludge flowing in partly filled pipes or open channels, the Kennison nozzle is proving successful.

Wherever efficiency is the watchword in modern sewage treatment plants, one finds flow meters and controllers. There is the master raw sewage and master air meter, individual meters in the raw sewage pump discharge lines, meters measuring the flow to each primary settling and each aeration tank, meters on the mixed liquor lines after aeration, meters on the primary sludge, the return sludge, the sludge to final tanks, and the elutriation water. There may be a Parshall flume on the initial raw sewage by-pass line, and one on the final effluent.

The above is condensed from a paper read by Mr. Richardson before the New England Sewage Works Association in September.

Control of Underground Water

(Continued from page 27)

being loaded with water and silt from the surface. In most cases, if the pervious material is stopped 8" from the surface and the remaining 8 ins. is filled with reasonably good material, it will be satisfactory.

Width of Trench and Outlets

Trench Width.— For average conditions, there should be at least a 6-inch thickness of ¼-inch to ½-inch material between the outside of the pipe and the side of the trench. For bad conditions, the thickness of pervious material should be greater than this on the wet side. For exceptionally bad conditions, a vertical layer of coarse sand should be provided next to the sides of the trench, with the main body of the trench filled with the usual size of material.

Outlets.—Many otherwise adequate subdrains have been made inoperative through lack of an adequate outlet. There is no sense in spending hundreds or thousands of dollars on a subdrain installation and then having it fail for this reason.

Most subdrains carry silt at times. The silt will start to deposit when the velocity of flow is reduced. Knowing beforehand that this will take place, we must try to make allowance for it. Do not outlet a subdrain into the highway gutter, or flush with the surrounding ground. Raise the outlet up several inches wherever possible.

First Year of Operation of Liberty Plant

(Continued from page 15)

Recirculation to the primary filter was discontinued on Sept. 15, and this apparently markedly affected the primary filter. Operation will be continued on this basis with the hope that additional operating information will be obtained.

Operating Personnel

The plant is operated by one of the writers with some additional labor assistance drawn as needed from the street forces. Accurate determination of operating costs for the various processes and steps has not yet been made.

(Answers to Questions on Page 36)

THE approved answers to the questions in the "Quiz Program" at the Engineering Section Dinner of the A.P.H.A. are as follows:

I. Water Purification. 1. Aluminum sulphate. 2. Ferric chloride. 3. Chlorinated copperas. 4. Copperas with lime. 5. Sodium Aluminate. 6. Chlorinate. 7. 125 million gallons. 8. Chlorine.

II. Sewage Disposal. 1. Imhoff. 2. New York City. 3. Chicago. 4. Milwaukee, Chicago, San Antonio. 5. Gray Fungus. 6. Activated sludge. 7. Methane CH_4.

III. Chemistry. 1. 35.46. 2. 1. 3. NaCl. 4. $Al_2 (SO_4)_3.18H_2O$. 5. By adsorption. 6. Chemical Reaction. 7. Temporary, Bicarbonates of Ca & Mg.; Permanent, Sulfates, carbonates & chlorides. 8. NH_2 Cl.

IV. Bacteriology. 1. Germ, Microbe, Micro Organism. 2. Chlorination. 3. Lactose. 4. After 23½ hrs. 5. Escherichia Coli. 6. A submicroscopic parasite on bacteria. 7. A physician of Verona (Italy) in the 15th century who postulated that disease was caused by a living entity. 8. 1. Typhoid; 2. Syphilis; 3. Diphtheria; 4. Anthrax; 5. Gonorrhea; 6. Tuberculosis; 7. Syphilis. (Note: Pasteur's name is intimatedly associated with rabies but this is a virus disease—not a bacterial disease.)

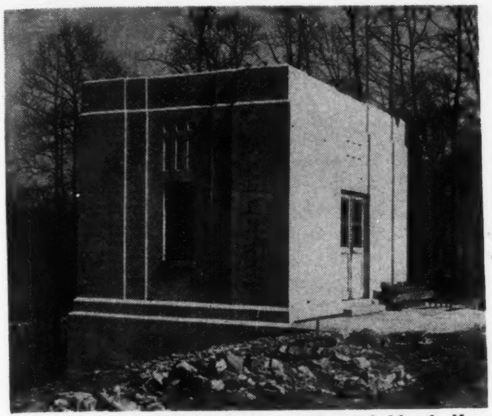
V. Well Known Men Currently in Public Health. 1. Bill Orchard. 2. George W. Fuller; Abel Wolman. 3. Sol. Pincus. 4. W. A. Hardenbergh. 5. Harry B. Hommon. 6. James Lloyd Barron. 7. Linn Enslow.

VI. Chlorination. 1. True. The Federal Food, Drug and Cosmetic Act of 1938 defines a food as a substance used as a food for man or other animal, or a substance used to process food for man or other animal. Chlorine is used to make a number of sanitizing agents used to process foods. From a regulatory standpoint, it is, therefore, a food when so used. 2. False. Some of the chlorine reacts chemically with the water, and, therefore, the quantity of chlorine taken up by the water is greater than that which would be dissolved according to Henry's Law. 3. Liquid chlorine is classified *only* as a compressed gas. 4. 5,000 parts per million is specified for Army use and has been generally accepted as the correct minimum by the Food and Drug Administration for labelling accuracy. 5. Between 20,000 and 30,000 tons. 6. Chlorine will destroy only those organisms which are susceptible to chlorine. It will not entirely compensate for coagulation or filtration deficiencies. 7. Major C. R. Darnall at Fort Meyer, Va., in 1910. 8. In World War I, chlorine itself was a military failure as a war gas. The Army and Navy are acquiring it today for processing of other war gases, smoke screen materials and other items of National Defense.

VII. Famous Names in Public Health. 1. Chief Engineer Metropolitan Water Board of London, England—the "father of chlorination." 2. Dr. Reid proved that the female aedes aegypti mosquito was the transmitter of yellow fever. 3. General Gorgas instituted mosquito control to eliminate yellow fever and malaria in Panama, thus making it possible to complete the Panama Canal. 4. Prof. of Public Health Engineering at Massachusetts Institute of Technology. 5. A former Surgeon General of U.S.P.H.S. 6. A noted French scientist credited with much original bacteriological research particularly with rabies. Also the father of Pasteurization, first practiced in connection with wines and later adapted to milk, beer and other foods. 7. Credited as the first man to demonstrate that an epidemic could be traced to a water supply. London cholera epidemic 1854. 8. German bacteriologist who first isolated the bacterium of tuberculosis.

VIII. Define Public Health Engineering Terms. 1. The level to which water will rise in vertical open pipes at various points of a distribution system. 2. A genus of mosquito, the female of which is a malaria carrier. 3. A sterilizing agent used in water purification. It is a compound of chlorine and ammonia. 4. The process of forming floc in water to settle out suspended solids. 5. A term used in connection with filter sand; such that 10% of the material is of smaller grains and 90% is of larger grains than the size given. 6. A connection between a potable water supply and a source of pollution. 7. In connection with the use of chemicals in water treatment, that portion of chemical remaining after reaction has taken place, usually. 8. The presumptive test for B. Coli, performed by fermentation of lactose, gives an indication of the presence of pathogenic bacteria in water.

IX. Fields of Public Health Engineering Activity and Their Purpose. 1. Water Purification. 2. Sewage Treatment. 3. Swimming Pool Sanitation. 4. Drainage. 5. Mosquito Control. 6. Ventilation. 7. Street Cleaning. 8. Garbage and Refuse Collection. 9. Incineration. 10. Industrial Hygiene.



Gate house at sedimentation tank of Ashland, Ky., waterworks.

The Waterworks Digest

Abstracts of the main features of all important articles dealing with waterworks and water purification that appeared in the previous month's periodicals.

Variations in Meter Rates

From a study of rates and local conditions the author concludes that, in general, rates are inversely proportional to the 0.2 power of population, directly proportional to elevation above sea level, vary with remoteness of supply and inversely as density of population. Non-citizens pay up to 100% more than citizens. Rates are higher in hilly or rocky country. Discounts for prompt payment vary widely. Complete filtration increases cost of operation about 10%. Private companies must charge more than municipalities. Consumer-borne costs of service lines should decrease rates about 5%. Periodic rebates, based on earnings, are the best method of control and management. Water departments should be self-sustaining and should be operated as independently as possible, with meter rates as a foundation of financial practice.[G 42*]

Comparing Efficiencies Of Filter Washing Methods

The method of comparing efficiencies of filter washing selected by the author was the sodium hydroxide color test, in preference to the sulfuric acid color, loss on ignition or alum test. This consists of placing a sample of sand in an 8 oz. prescription bottle, adding a known volume of sodium hydroxide solution, and shaking a definite number of times; storing for 24 hrs., then diluting with distilled water and reading against color standards. Varying the strength of sodium hydroxide from 1 to 20% made no appreciable change in amount of color removed. Shaking 25 times was selected; further shaking did not affect the color.

Three plants were tested, one an old wooden filter using low-velocity wash with rakes; one using air for 3 min., then water for 5 min. with vertical rise of 15" per min.; the third washed with water alone, with vertical rise of 22" to 28" per min. In the last, the top inch of sand had an effective size of 0.31 mm and an average for the bed of 0.50 mm, and 57% of the dirt was removed by the top inch and 95% by the top 5". The other two were practicaly uniform throughout with effective sizes of 0.59 and 0.62 mm, respectively, and the top inch removed only 14% and

*See Bibliography in November issue.

HOW TO FIND ORIGINAL ARTICLES. Key letter at end of each digest refers to name of publication listed in bibliography at end of this section. Numeral indicates title of article.

90% of the dirt, respectively. The washing method using rakes seemed to be more efficient than the other two methods.[B 34*]

Length of Mains and Population

Studies of the distribution systems in 129 municipalities suggested obtaining equations showing the relations between population and number of hydrants, IF (inch-feet of mains), and ISF (inch-square-feet of mains). The last was recommended by the author as more logical than the common inch-foot, and was obtained by multiplying the length of each size of pipe by the square of its diameter in inches and adding all the products. The equations obtained were:

Hydrants per thousand population $= 28/D^{1/3}$

IF units per capita $= 170/\sqrt{D}$

ISF units per capita $= 1125/D^{1/3}$

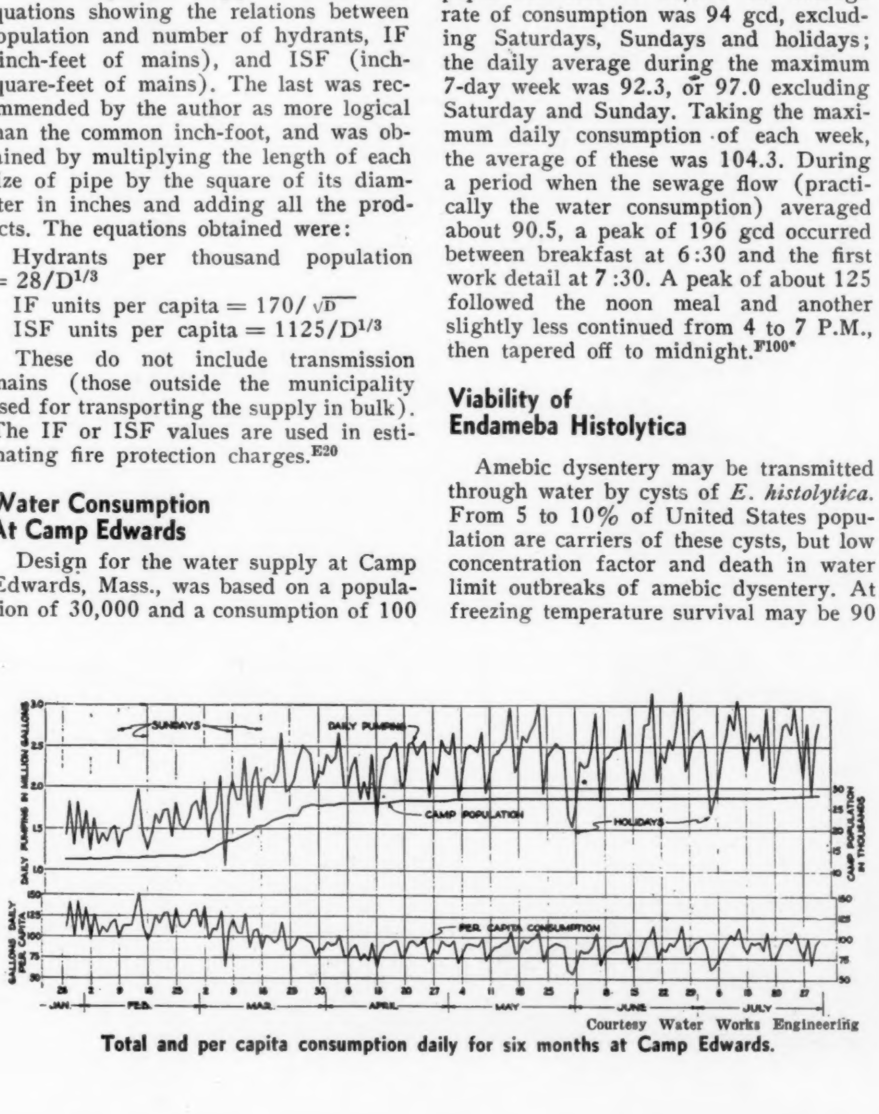
These do not include transmission mains (those outside the municipality used for transporting the supply in bulk). The IF or ISF values are used in estimating fire protection charges.[E20]

Water Consumption At Camp Edwards

Design for the water supply at Camp Edwards, Mass., was based on a population of 30,000 and a consumption of 100 gcd average, 250 gcd peak. Actual figures for the period Jan. 27 to July 30, 1941, are given in this article. Beginning with 13,000, the population rose to 26,000 in March and 28,000 in July. The daily per capita consumption fell from about 115 at first to about 90 when the population reached 25,000. During the summer months the consumption averaged about 95 gcd based on weekly consumption records excluding holidays. Consumption fell off on Saturdays and Sundays because of week-end furloughs, and reached a peak on Friday. After the population rose to 26,000 the average rate of consumption was 94 gcd, excluding Saturdays, Sundays and holidays; the daily average during the maximum 7-day week was 92.3, or 97.0 excluding Saturday and Sunday. Taking the maximum daily consumption of each week, the average of these was 104.3. During a period when the sewage flow (practically the water consumption) averaged about 90.5, a peak of 196 gcd occurred between breakfast at 6:30 and the first work detail at 7:30. A peak of about 125 followed the noon meal and another slightly less continued from 4 to 7 P.M., then tapered off to midnight.[F100*]

Viability of Endameba Histolytica

Amebic dysentery may be transmitted through water by cysts of *E. histolytica*. From 5 to 10% of United States population are carriers of these cysts, but low concentration factor and death in water limit outbreaks of amebic dysentery. At freezing temperature survival may be 90



Courtesy Water Works Engineering

Total and per capita consumption daily for six months at Camp Edwards.

days, 30 days at 50°, 10 days at 68° and 3 days at 86°. Chlorine requirements for destruction are decreased with rise of water temperature, contact time and lowering of pH value; increased as density of cysts increase.[A139]

The Boston Pressure Aqueduct

The new pressure aqueduct bringing the Quabbin supply to Boston consists of 9,680 ft. of 150″ cut-and-cover, 67,700 ft. of 138″ cut-and-cover and 2,300 ft. of 84″ cut-and-cover; also 15,820 ft. of 168″ tunnel. The cut-and-cover sections were made as precast reinforced concrete pipe embedding a steel cylinder which carries 40% to 50% of the internal pressure, which varies from 100 to 220 ft. head. The concrete was chiefly for protecting the steel from corrosion and to prevent distortion under handling and from outside pressure, and was 12″ thick in the 150″, 11″ in the 138″, and 5″ in the 84″. Joints were made of steel joint rings into which a pre-formed lead gasket was caulked. The 150″ and 84″ pipe were made in 12 ft. lengths and the 138″ were 16 ft. Curves were made by using pipes with ends beveled 4.5°, the joints allowing a leeway of 1″ in length. The location of every joint in the line was determined exactly before the pipe was distributed. Connections for blow-offs, air valves, etc., were made of steel castings welded to the steel cylinder of the pipe. At two points valves are inserted, the line here being reduced to 108″ and then bifurcated by Y's into two short 60″ lines with a 60″ valve in each. The pipe was made by the Lock Joint Pipe Co., and laid by three different contractors.

The pipe was laid chiefly in cuts about 10 ft. deep with embankment 2 ft. 6″ above top of pipe. Drainage across the pipe line was by inverted siphon culverts, ordinarily 2 x 3 ft. section; with spillways in long stretches of embankment formed by depressing the embankment for a length of 10 ft. between concrete cross walls. Where the ground water level was more than 7 ft. above the invert of the pipe it was weighted down with heavy concrete cradles. In swampy areas and quicksand the trench bottom was stiffened by use of crushed stone. One of the contractors laid the pipe by means of a locomotive crane travelling in the bottom of the trench; another used a special Gantry crane; and the third used two cranes, neither capable alone of lifting a 45-ton pipe. In swamps, a gravel fill was placed on each side of the proposed excavation, and as this was dug the gravel sunk and formed dams to keep out the soft muck. In freezing weather the bottom of the trench was thawed by stretching canvas over it and introducing live steam below it through pipes.

In making the pipe, a special cement was used according to specifications developed by Thaddeus Merriman for securing a very tough, dense, impervious concrete. An 84″ pipe was tested to destruction, bursting at a welded joint at 4½ times the design load; the concrete cracked uniformly around the outside of the pipe, but that inside cracked at only one place, letting the hydrostatic pressure through, then separated from the steel cylinder. In the final leakage test the 150″ pipe lost 1,057 gpd per mile, the 138″ lost 1,598, 1,682, and 3,057 gpd respectively in three test sections.

The costs of pipe delivered averaged, per foot, $58.37 for 150″, $52.63 for 138″ and $29.90 for 84″. Laying averaged, per foot, $51.03 for 150″, $31.18 for 138″ and about $30 for 84″.[B29]

Ground Water Supply of Houston

Houston, Tex., population about 390,000 is the largest city in America obtaining its supply solely from ground water. This comes from sands 600 ft. deep above a 2,000 ft. depth. In 1910 this artesian water rose 30 to 50 ft. above sea level; then fell about 5 ft. a year until 1930, when consumption fell 10% and pressure rose. Since 1937 withdrawal of water increased from 50 mgd to 70 mgd, and to 81 mgd in 1941, and the water level dropped 30 ft. during those three years. Each foot the level drops increases the cost of pumping $10 per annum for each mgd.

The municipal works furnish less than 40% of the consumption, the rest being obtained from private wells by commercial buildings and industries, chiefly in a large industrial area along the ship channel. Investigations, partly Federal, show that increase in rate of pumping will lower the water level and deplete the ground storage more rapidly than it is recharged, cause intrusion of salt water, and make cost of pumping excessive.

A supplementary supply of ground water exists north of Houston, but a supplementary supply of ground water from the San Jacinto river is favored, which will provide 100 mgd.[A144]

Cement Lining Of Water Mains

Akron, Ohio, in 1940 lined 20,000 ft. of 36" and 14,000 ft. of 48" steel force mains. To do this, 36 openings were cut in the pipe to admit materials and then welded back in place. Five of these welds cracked during the next 6 or 8 months, causing leaks, which were repaired by welding larger plates on the outside of the pipe; the heat from which welding loosened the cement lining in two places, at which places the loose cement was removed and replaced.[A134]

Toledo has lined 26,700 ft. of 48" and 60" new steel pipe. Some hair cracks formed, but after 8 months' use practically all had disappeared. Test of the 48" pipe 1½ year after completion showed a C of 141. On one contract bids for lining the larger pipe were $2.50 per lin. ft. for cement and $0.75 for bituminous, but the pipe was made 1/16 in. less in plate thickness for cement, which offset the greater cost of this lining in this contract; but on all other contracts the bids for bituminous lined pipe were less even with this differential.[A135]

Cincinnati in 1940 cement lined 5,123 ft. of 48" cast iron pipe laid in 1907. Before lining the coefficient C was 93; after lining it was 143.[C136]

Shamokin, Pa., in 1940-41 cement lined 10" pipe, increasing C from 58 to 141 on nominal diameter. In Wilkinsburg, Pa., C was increased from 64 to 140 on nominal diameter.[A138]

Fittings for Steel Pipe

Flanges for steel pipe are often made too heavy by waterworks engineers, since the standards are applicable to high temperatures. For cold water, a 150 lb. standard is safe for 230 lb., and a 300 lb. standard for 500 lb. Slip-on type flanges are best for waterworks service. This is true for standard elbows and other fittings also.[A142]

Special Rates And Free Water

Special rates have been opposed on grounds of legality and public policy. Legally, all consumers must be served without discrimination; but can be classified for rate purposes on the basis of "reasonable differences in facts and circumstances." Some arguments pro and con re. policy are: Special rates for sprinkling lawns in a dry season may cause dangerous shortage of water. Granting free water for public use gives the taxpayer a benefit at the expense of the water user. Off-peak use is the only reasonable application of special rates. Fort Dodge, Ia., makes no charge for sprinkler systems, as they use less water to put out a fire than would be used from hydrants alone if the sprinklers did not stop it in its early stages. Iowa state laws prohibit special rates or free water service. Duluth has no free water or special rates to any service—churches, schools or city. Greenville, S. C., believes that "everyone (including non-taxpayers) should contribute toward the upkeep of public services and institutions" and has ceased charging the city for these services. As that city furnishes water for the suburbs, it thus makes them help support parks, libraries, etc., that they use. In New Orleans, only 55% of the water pumped is paid for; free water for public and charitable institutions is justified because a small percentage of the population pay taxes, and the cost of benefits shared by the entire population is thus distributed over a much greater percentage of the population. On the other hand, Denver, Colo., believes that the benefits derived from public schools, parks, streets, etc., are seldom in the same ratio as the water bills but more nearly in that of the taxes; also, service given free is not appreciated and leads to waste.[A129]

Special rates for Federal housing developments is a growing problem. Last June 383 such projects in 37 states were in use or under construction, and Administrator Straus says that he expects special rates for these, in order that low

rents (which include water, gas, etc.) can be charged. Where a low rate is obtained by serving the entire project through one master meter and paying at the standard wholesale rate, this is generally appoved —there is no credit risk or cost of collection. Otherwise, there is considerable objection. It discriminates against tenants of other property whose incomes are similar but who are buying a home or renting from a private landlord.[A130]

Meter Rates and Affecting Conditions

From a study of rates in cities of all sizes, with various sources of supply, degrees of treatment, elevations above sea level, topography, etc., the following conclusions were reached: 1—Rates are inversely proportional to the 0.2 power of population. 2—Rates are directly proportional to elevation. 3—Rates vary with remoteness of supply, i.e., the nearer the supply, the lower the rate. 4—Consumers living in areas outside city limits pay up to 100% more than those located in the city. 5—Discounts for prompt payment are by no means uniform. 6—Surcharges on bills, invoked during the depression, have in many cases become permanent. 7—Periodic rebates, based on earnings, are the best method of control and management. 8—Water departments should be self-sustaining and should be operated as independently as possible, with meter rates as a foundation of financial practice. 9—Metropolitan areas have in all cases aggravated rate problems. Reasonable regulation in each such area is desirable. 10—Complete filtration increases cost of operation about 10 per cent. 11—Rates vary inversely as the density of population, except in some very large cities. 12—Rates in hilly country are higher than in flat country. The presence of rock also increases rates. 13—Private companies must charge more than municipal departments, largely because of taxes. 14—Consumer-borne costs of service lines should decrease rates about 5 per cent, and vice versa.[A132]

Meter Setting Inside or Outside

A special committee of the Indiana Section AWWA, reported on inside vs. outside meter settings. *Outside settings* are more accessible; reading causes less inconvenience to the consumer; repeat readings are eliminated; no water in basement from leaky meter; aid in preventing leaks between basement and property line. Less danger of freezing than in poorly constructed basements. Reduces ability of consumer to tamper with meter. But: cost of installation is higher; meter dials become dirty and clouded; more danger of freezing in some localities. *Inside settings* cost less; less danger of freezing in most cases; not affected by snow and ice; meter easier to read and to remove for repairs; meter settings not affected by changing street grade. But: repeat trips often necessary; reading is inconvenient to consumer; basement floor is wet by leaky meter; consumers may block access to meter or tamper with it; water is lost between curb cock and basement.[A133]

Pressure Spheroid Water Tank

Will Rogers Field, Oklahoma, is served with water from the supply of Oklahoma City, five miles away. Ordinarily the city pressure is sufficient, but should it fall for any reason, booster pumps drawing water from the mains pump it into a 330,000 gal. Hortonsphere, producing a pressure of 30 lb. at the top of this storage tank, which is 50 ft. above the ground at the air field, where it is located. When the pressure exceeds 30 lb., the pumps are automatically stopped, and if it falls below 25 lb. they are automatically started again. Also a gasoline-electric standby generator unit is automatically brought into service should the commercial electric power supply be interrupted.[J22]

Chlorine Cylinder Safety

During the 20 years that ton containers of chlorine have been employed, only four accidents have occurred in water or sewage plants. In one, the building burned down but water played on the container kept it cool and no gas escaped. In another, the copper connecting tube was broken, but closing the container valve

stopped escape of chlorine. The other two occurred on the New York City water system. In one, a ton container while being moved was dropped a foot onto the floor and cracked at a welded seam; seams are now being made stronger. In the other, two practically empty containers exploded. This was found to be due to presence of ammonia from the salt brine used in chlorine manufacture; methods of manufacture have been modified to eliminate such accidents.[X56]

Bibliography of Waterworks Literature

The articles in each magazine are numbered continuously throughout the year, beginning with our January issue.

c. Indicates construction article; *n*, note or short article; *p*, paper before a society (complete or abstract); *t*, technical article.

A *Journal, American Water Works Ass'n.*
October

129. Special Rates and Free Water Service. By D. L. Maffitt. Pp. 1627-1637.
130. Special Rates for Federal Housing Developments. By H. F. Smith. Pp. 1638-1647.
131. Finance and Accounting of Denver's Water System. By G. F. Hughes. Pp. 1648-1652.
132. Relation of Meter Rates to Distribution System Conditions and Other Factors. By C. H. Capen, Jr. Pp. 1643-1665.
133. Meter Settings. Indiana Section Committee Report. Pp. 1666-1670.
134. *c.* Cement Lining of Water Mains at Akron, Ohio. By W. R. La Due. Pp. 1671-1681.
135. Cement Lining of Water Mains at Toledo, Ohio. By G. N. Schoonmaker. Pp. 1682-1692.
136. Cement Lining of a Water Main at Cincinnati. By C. A. Eberling. Pp. 1693-1694.
137. The Development of Cement Lining of Water Mains. By H. S. Jones. Pp. 1695-1699.
138. Cleaning and Cement Lining Water Mains in Place. By B. Harkness. Pp. 1700-1704.
139. *t.* Viability and Destruction of the Cysts of *Endameba Histolytica.* By S. L. Chang and G. M. Fair. Pp. 1705-1715.
140. Current Activities of the Steel Pipe Committee. By W. W. Hurlbut. Pp. 1716-1722.
141. Mechanical Application of Bituminous Pipe Coatings and Linings. By L. E. Goit. Pp. 1723-1750.
142. Fittings and Specials for Steel Pipe. By R. E. Barnard. Pp. 1751-1762.
143. Cleaning and Lining With Bituminous Enamel. By J. M. Kamps. Pp. 1763-1767.
144. Development of Houston's Water Supply. By G. L. Fugate. Pp. 1768-1778.
145. Equipment Available for Emergency Repairs to Distribution Systems: Portable Pumping and Power Equipment. By N. Thompson. Pp. 1779-1786. Temporary Make-ups and Line Caps. By C. Inglee. Pp. 1786-1789. Main and Joint Repair Equipment. By R. S. Scott, Pp. 1790-1800. Emergency Repairs to Distribution System. By H. Y. Carson. Pp. 1800-1803.
146. Revising the U. S. Standards for Drinking Water Quality: Some Considerations in the Revision. By J. K. Hoskins. Pp. 1804-1807. Drinking Water Standards. By C. R. Cox. Pp. 1807-1818. Revising the U. S. Standards. By G. D. Norcom. Pp. 1819-1824. Water Purification Plants and Water Quality Standards. By J. R. Baylis. Pp. 1824-1831.

E *Engineering News-Record*
October 23

19. Miami Buys a Distribution System. By C. F. Lambert. Pp. 89-90.

November 6

20. What Charge for Fire Protection. By C. H. Capen. Pp. 67-69.

F *Water Works Engineering*
October 22

102. Meter Practices of Newark, N. J. By W. G. Banks. Pp. 1320-1323.
103. Treating Mississippi River Water. By H. S. Molter and R. L. Tacker. Pp. 1324-1326.

November 5

104. Changes in Utility Operations. By L. A. Smith. Pp. 1378-1381.
105. *p.* Financing Main Extensions for City or Developments. By W. P. Melloy. Pp. 1390-1420.

November 19

106. Water Practices of Augusta, Me. By N. N. Wolpert. Pp. 1444-1447.

J *American City*
November

22. Water Supply for Will Rogers Air Feld. Pp. 42-44.
23. Artesian Water Supply for Stillwater, Minn. Pp. 60-61.

P *Public Works*
November

49. *p.* Construction of Charleston's Edisto-Goose Creek Tunnel. Pp. 15-16, 35-37.
50. Million Dollar Improvements for Everett Water Supply. P. 20.
51. *n.* Control of Water Pipe Line Laid in Highway. P. 37.

W *Johnson Nat'l Drillers Journal*
September-October

6. The History of Ancient and Modern Wells. Pp. 1-7.

X *Proceedings, Maryland-Delaware Water and Sewerage Ass'n.*
Year of 1941

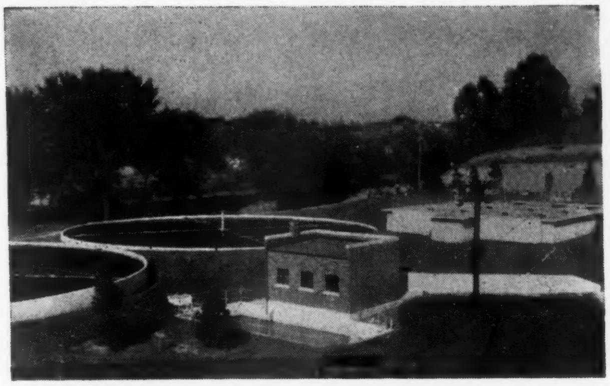
56. Treatment and Sterilization of Air-conditioning Water Supply. By H. Stevens. Pp. 4-15.
57. *c.* Laying Large Collecting Mains in an Operating Filtered Water Reservoir. By L. E. McClung. Pp. 22-29.
58. Obsolescence of Water Plant Equipment. By E. S. Hopkins. Pp. 30-33.
59. Water Bacteriology and Chlorine Residuals. By J. W. Krasauskas. Pp. 35-37.
60. Some Chlorination Observations—Mostly Unimportant. By L. L. Hedgepeth. Pp. 38-45.

X *Bulletin, North Dakota Water and Sewage Works Conference*
September, 1941

61. Threshold Treatment. By O. Rice. Pp. 15-17.
62. New Equipment at the Bismarck Water Treatment Plant. By W. Yegen. Pp. 20-21.
63. Recarbonation With Lignite at Jamestown. By S. T. Monek. Pp. 30-31.

The Sewerage Digest

A Digest of the Sewerage Literature of the Month giving the main features of all the important articles published.



Sewage treatment plant at Collinsville, Ill.

Pumping Water With Suspended Solids

Though considering chiefly dredge pumps, the conclusions reached by the experiments described in this article apply also to pumping sewage and sludge. In general, these are that, when handling materials in suspension, the head developed is less than that with water alone, varying with particle size as well as concentration; the effect of colloidals differing from that of particles in true suspension. The capacity at maximum efficiency is about constant for various concentrations and sizes of suspended materials.[K 2]

Laboratory Control Of Treatment Plants

The functions of a sewage treatment works laboratory include the following: 1. To obtain representative basic data from which a disposal plant can be properly designed or revised and enlarged. 2. To gather information on the operation and ascertain the results accomplished. 3. To conduct analytical tests which will afford control of various processes of treatment. 4. To study the body of water receiving the effluent in order to ascertain the success of the treatment. 5. To analyze and test supplies and materials (particularly chemicals) as a basis of payment or rejection. 6. To study industrial wastes discharged into the sewers and ascertain their effect on sewerage and sewage disposal structures and treatment processes. 7. To conduct research leading to the improvement of processes and operation. 8. To analyze miscellaneous substances and conduct miscellaneous experiments.

Laboratory control is essential to efficient operation of activated sludge process, biofiltration, chemical precipitation, chlorination, sludge digestion and conditioning.[M 12]

Tanks at the Anacostia Works

In the ground around the sedimentation tanks at the Anacostia plant (Washington Suburban Sanitary District) the ground water level was just below the ground surface, and the tanks when empty would float. To prevent this, tide gates opening inward permit ground water to enter when

HOW TO FIND ORIGINAL ARTICLES. Key letter at end of each digest refers to name of publication listed in bibliography at end of this section. Numeral indicates title of article.

the sewage is removed. If it is desired to empty the tanks, the ground water around them can be lowered by a pump connected to a tile drain surrounded by gravel laid around the foundations of the tanks.

The various units of the plants are connected by tunnels containing the various pipe lines, except that the sludge-gas pipes are laid in an outside trench to minimize the explosion hazard. The use of such tunnels is becoming popular even in small plants and is much appreciated by operators.[X 44*]

Factors Influencing Vacuum Filtration

The factors influencing vacuum filtration listed and discussed by the author are: 1. Amount of moisture present per pound of solids. 2. Amount of volatile matter present per pound of solids. 3. Amount of bicarbonates and other biochemical reagents dissolved in No. 1 and measured per pound of sludge solids. 4. Kind of coagulent used, i. e., trivalent chloride or sulfate or both, with or without lime. 5. Amount of coagulent used per pound of sludge solids and per pound of volatile solids. 6. Cake thickness and filter yield, lbs. dry sludge solids per square foot filter area per hour. 7. Resistance of cake to filtrate flow, i. e., coarse or fine floc and stability of floc. Cake sloughing. 8. Time or filter speed in minutes per revolution, or revolutions per hour. 9. Resistance of permanent medium to filtration, i. e., kind of cloth and condition due to continued usage and is all cake being discharged. 10. pH of filtrate, which may influence viscosity of filtrate. 11. Temperature of sludge. 12. Vacuum, amount measured in inches mercury. 13. Uniformity conditions.[X 45*]

Treating Gas Plant Waste

Experiments at the sprinkling filter plant of Fargo, N. D., on effect on the plant of phenols and tarry acids discharged into the sewers by a gas plant, led to the conclusions that biological treatment, as by trickling filters, will remove practically all the phenol from sewage if the concentrations are not excessive. Since the phenol is in solution, practiaclly none is removed in the clarifiers, and none reaches the digesters. Tarry acids are present in a colloidal state and are absorbed by the bacterial film in the filter but are not decomposed to any extent and accumulate in the filter as coatings that slough off. By using one half of a filter until the tarry residue begins to clog it and then changing to the other half while the first one unloads, filter operation has been greatly improved.[X 49]

*See Bibliography in the November issue.

Bibliography of Sewerage Literature

The articles in each magazine are numbered continuously throughout the year, beginning with our January issue.

c. Indicates construction article; *n,* note or short article; *p,* paper before a society (complete or abstract); *t,* technical article.

J *American City*
November

21. New Sewerage System and Primary Treatment Plant for Duluth. Pp. 66-68.

K *Proceedings, Am. Soc. of Civil Engineers*
October

2. *t.* Effect of Suspended Solids on Characteristics of Centrifugal Pumps. By L. C. Fairbanks, Jr. Pp. 1422-1433.

M *Water and Sewage*
October

12. *p.* Laboratory Control in Sewage Treatment Plant Operation. By G. E. Symons. Pp. 26-27, 54-58.
13. *p.* Disposal of Sludge from Sewage Treatment Processes. By W. L. Malcolm. Pp. 28-29, 73-77.
14. *p.* Methods of Sewer Cleaning and Maintenance. By R. J. Desmarais. Pp. 30, 58-61.
15. *p.* Grand River Conservation. By M. Pequegnat. Pp. 36, 38, 62, 64, 66.
16. *p.* Grand River Sewage Dilution Problem. By A. L. Hanenberg. Pp. 40, 78-80.

P *Public Works*
November

43. Sewage Sludge Digestion at Marion, Ind. By D. Backmeyer. Pp. 12-14, 31-32.
44. Sewage Treatment Plant for Pendleton Airfield. P. 17.
45. *p.* Deriving Gas Engine Operating Costs and Standardizing Reports. By R. W. Frazier. P. 34.
46. *n.* Frogs Clog Sewage Distributor. P. 37.

X ***Bulletin, North Dakota Water and Sewage Works Conference***
September, 1941

47. The Two-Purpose Sewerage System. By M. M. Cohn. Pp. 12-14.
48. Two Years' Operation at Dickenson Treatment Plant. By E. A. Tschida. Pp. 18-19.
49. Effect of Low Concentrations of Gas Plant Waste on the Fargo Treatment Plant. By J. H. Stewart. Pp. 22-23.
50. Imhoff Tank Operation. By K. C. Lauster. Pp. 26-28.

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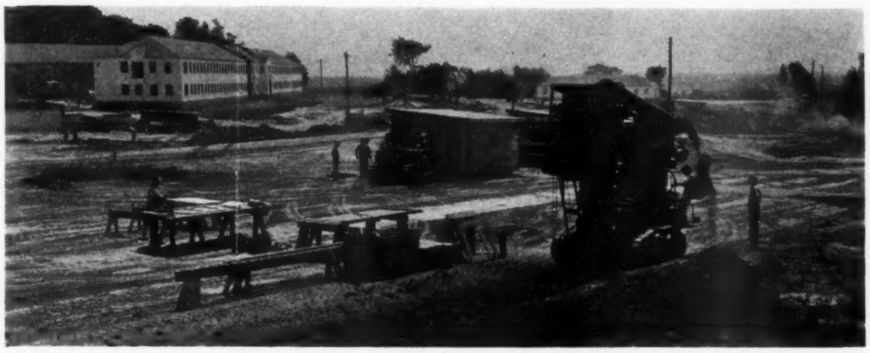
Keeping Up With New Equipment



Barber-Greene Vertical Boom Ditcher speeds construction at Ravenna Shell Loading Plant.

Vertical Boom Ditcher

Barber-Greene Co., Aurora, Ill.

Modern equipment, efficiently employed, is speeding National Defense construction ahead of schedule—America's "secret weapon." The illustration shows a Barber-Greene Vertical Boom Ditcher digging a building foundation trench at the Ravenna Shell Loading Plant. The ditcher has an 8′ 3″ boom and is used for all types of trench digging of various depths to capacity trenches for drainage, sewer and bombproof conduits.

In the contract, held by Hunkin-Conkey Construction Company, are 116 miles of railroads, 70 miles of highway and 900 buildings. The permanent administration building is seen in the background at the left. Barber-Greene Asphalt Finishers are being used to put down the highways also.

Ink-like Results With Pencil on New White Tracing Cloth

Frederick Post Co., Box 803, Chicago

This company claims that good, clear blue prints are made from pencil tracings on its new white tracing cloth, Whitex, and that every pencil mark or line is dense and sharp. It is tough, durable and will not discolor with age. Its glossy "stay clean" back is an added feature and its extra transparency adds speed to print production.

Because of the high degree of transparency and the texture that results in "ink-line" density from hard pencil, you will get "jet-black-on-pure-white" positive prints as well as knife-sharp major contrast blue prints from pencil drawings on Post's Whitex.

Whitex also erases quickly and cleanly with art gum or a soft eraser and erasures do not show on the blue print. Detail does not smudge or rub off. Whitex takes colored pencils sharply and cleanly. It enables the draftsman to produce a fine detail and at pencil speed, ink quality, contrasty, professional-looking blue prints—from pencil drawings. Samples of Whitex can be obtained by writing the company.

Quick Chlorination

%Proportioneers%
9 Codding St. Providence, R. I.

%Proportioneers% announces a new unit—the Fluid Drive Chlor-O-Feeder—designed for feeding all chemical solutions which will not attack rubber and "See-Thru" plastic, into flows from constant or variable rate reciprocating pumps.

Operation—Automatic and flow proportional.

Control, and Motive Power—Hydraulic impulses from water pump cylinder.

Maximum pressure 150#/sq. in.

Maximum treating capacity 45 GPM pump.

Maximum stroking rate 60 SPM.

Dosage adjustment while in motion by means of a micrometer type stroke setting knob.

Operation on differential pressures.

Simple to install. Simple to operate. High in performance. Low in price.

Complete with Midget Ortho Kit and all accessories except crock.

Only one pipe or hose connection to controlling pump. No electric current necessary, no water meter required.

The simplicity of construction, installation and operation of this feeder makes it especially adapted for use by non-technical personnel. Can be installed in 10 minutes on most jobs.

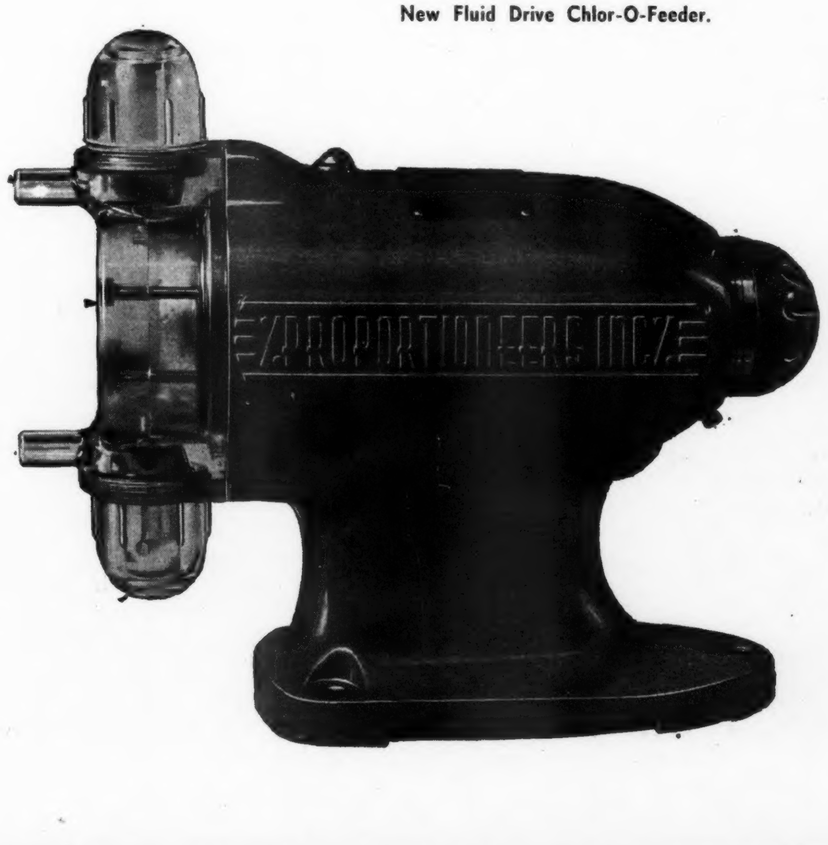
Vinsol Resin for Reducing Surface Scale on Concrete Highways

Hercules Powder Co.
Wilmington, Del.

Reduction of surface scale in concrete highways may be accomplished by the use of a resin derived from pine-wood. Additions of small amounts of this product, Vinsol Resin, by the cement manufacturer to the clinker during grinding almost completely eliminate surface scale and greatly reduce progressive scale, the company says. Improved workability is also reported by contractors who have used the resin-treated cement in large-scale field tests.

Laboratory and field tests conducted by state highway departments and cement companies show that additions of up to .05% of the resin to cement are sufficient to reduce scale produced by freezing and thawing. Complete information furnished by Hercules Powder Co.

New Fluid Drive Chlor-O-Feeder.



Motorists seem to like this new method of ending traffic jams.

Tournapass Eliminates Traffic Jams

LeTourneau Company of Georgia
Tournapull, Ga.

The standard Tournapass consists of three or more spans. End spans are hinged to the center span by means of giant, alloy-steel, heat-treated bolts which allow for a hinge action for adjusting the spans to different street elevations. All Tournapass posts are detachable by means of large draw-bolts, which with the LeTourneau "cloverleaf" adjustable steel piers—or bases—permit the specified street clearance and provide rigid, solid support, or "footing," for varying street elevations and uneven street contours for each post. The "cloverleaf" piers also act as wheel guards to protect both cars and span posts. The inside plates of the structural box-beam girders perform the dual purpose of being an integral part of the girders and acting as a "guard" to protect the tires, hub-caps, and car fenders; without adding an extra pound of unnecessary structural weight.

On a Tournapass tryout, between August 4th and 23rd, at Peachtree and Wesley Roads, Atlanta, Ga., approximately 55,000 cars and light trucks used the Tournapass. In this case, the standard Tournapass, a one-way single-lane overpass structure, competed with the regular two-lane level crossing, on which the light is green two-thirds of the time. The public had its choice. Yet, one Sunday's traffic count alone, from 7 A.M. to 9:15 P.M. showed: 4,685 cars and trucks went over the Tournapass; only 1,581 such vehicles took the alternate level route. This is for through traffic and does not include vehicles making turns. In other words, three out of four cars preferred the Tournapass. Write for folder on this modern, effective and economical method of eliminating traffic jams at busy intersections.

Sealing Compounds

Keystone Asphalt Products Co.
43 E. Ohio St., Chicago

Two asphaltic sealing compounds, hot pouring and cold troweling types, have been designed for sewer pipe joining, for use as caulking compounds in roof construction, and in other building work where a waterproof sealing compound is required.

A heavy cardboard container replaces the conventional steel drum for packing the hot pouring compound in 200-pound units. The package is sufficiently small to permit its full use in the average melting pot, eliminating all possibility of obtaining an improper mix between asphalt and filler. The cardboard container is easily stripped from the hardened cake of compound, facilitating handling on the job. Hot pouring type presents a mixture of petroleum asphalt and finely ground mineral filler in ratio designed to retain flexibility in cold weather, and to prevent erosion and flow in hot weather.

Cold troweling type compound is designed for use on smaller jobs where a melting pot for a hot pouring compound is not practical. When used to join sections of sewer pipe, it will remain sufficiently plastic so as to take up any natural pipe settlement.

Badger Convertible Shovels

Austin-Western Road Machinery Co.
Aurora, Ill.

The manufacturers say that the A-W Badger is built to dig, swing and dump fast. The ¾ swing design, anti-friction bearings, and the use of strong lightweight steels make it possible for the Badger to do more work—faster and longer. It is portable and easily convertible into a trench hoe, crane, clamshell and dragline. Write for a copy of the new bulletin and learn how versatile and profitable the Badger can be to you.

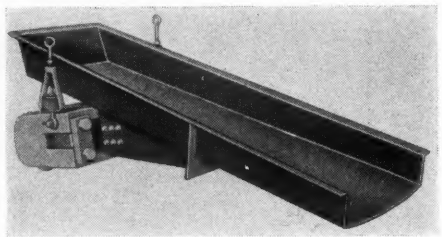
New, Heavy Vibratory Feeders

The Syntron Company
660 Lexington Ave., Homer City, Pa.

This company has added two new models of electromagnetic Vibratory Feeder Conveyors to their line. The Model F-4, illustrated, has a capacity of up to 100 tons per hour of material such as crushed rock, and carries feeder pans as wide as 36 inches and as long as 60 inches in size.

The larger capacity Model F-5 will handle as much as 500 tons per hour of such material and can be supplied with troughs as wide as 48 inches and from 60 inches to 96 inches long. These new models, like the smaller-capacity Syntron Feeders, are vibrated at high speed by a pulsating electromagnet. The exclusive, patented principle of energizing these magnets through the medium of a rectifier tube accomplishes the heavy tonnage capacity.

The finger-tip rheostat control of the rate of flow is claimed to permit a range of feeds from a rushing torrent down to a slow dribble. Another feature is the entire absence of moving parts, such as gears, cams, screws, discs, rollers, idlers, connecting rods, etc. Full and complete information in a new catalog just off the press is obtainable from the manufacturer.



Syntron Model F-4 Vibratory Feeder Conveyor.

New Literature on Link-Belt Speeder Shovel

Link-Belt Speeder Corp.
307 N. Michigan Ave., Chicago

A new 4-page Folder No. 1914 illustrating and describing its ½-yard Model LS-50 crawler shovel-dragline-crane, has just been published by Link-Belt Speeder Corp., 301 West Pershing Road, Chicago.

The folder particularly covers some of the new design features of this excavator, such as the machine's non-clogging crawler treads; alloy-steel, all-welded lower frame; and the simplified design of the upper machinery. Clearances, dimensions, lifting capacities and brief specifications are given. A copy of Folder 1914 will be sent to any interested reader on request.

Steel Piling Specification Book

Caine Steel Co., Chicago

The manufacturers claim that due to its design and unusual strength, this lightweight Corrugated Steel Sheet Piling is being used successfully on jobs where formerly products using twice as much steel to accomplish the same results have been specified. Because of this same lightweight and special design, Corrugated Steel Sheet Piling requires less valuable space in transporting, can be installed by lighter equipment in less time and with the use of unskilled labor, all factors which can in turn be applied to defense efforts.

An important factor in the contribution which Corrugated Steel Sheet Piling is making toward steel conservation

is, however, its high salvage value, which makes it possible for this product to be used, pulled and then reused again, time after time, and on job after job.

The new specifications book and catalog contains information that will be of value to construction men and engineers in every field. For a free copy write the Corrugated Steel Sheet Piling Division of the Caine Steel Company, Chicago.

2" Cast Iron Pipe

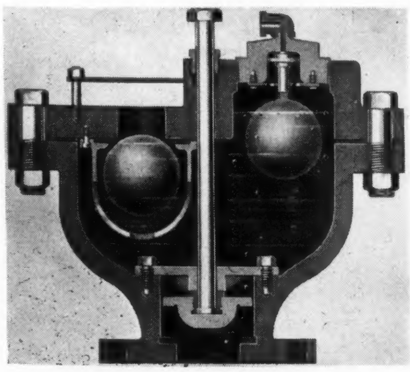
A new catalog of the McWane Cast Iron Pipe Company describes their 2-inch cast iron pipe and its various joints. The catalog is generously illustrated and contains full information, not only about the pipe but concerning methods of manufacture in their new "streamlined pipe shop." This is said to be the largest pipe foundry in the world devoted exclusively to making cast iron pipe in this one size—2 inches. Write the company at Birmingham, Ala., for your copy.

Ryan Purging and Automatic Air Venting Valves

Fred J. Ryan Company
5244 Germantown Ave.
Philaedlphia, Pa.

The type "A" valve is designed for use on pipe lines in which free air or gas may accumulate. One of its outstanding features is a large opening for filling or purging the lines without the operation of valves. The valve is constructed with a main body of metal and a top plate bolted to this main housing. Gaskets are especially designed to meet the conditions of the fluid within the lines. The purging ball is the free floating unit operating within the bronze cage. The pressure of the fluid within the chamber causes the ball to rise to its special rubber seat and there fit tightly in position, resisting all leakage until pressure of either fluid or atmosphere is released.

The manufacturers claim that the Ryan valve assures a rapid means of filling either pipe lines or storage tanks without opening and closing and are motorized valves. It also does away with the danger of overflow and its attendant hazard to life and property. Write for folder giving detailed information.



Cut-away view of Ryan Valve.

Cataphote Markers Ordered For Pennsylvania Highways

Western Cataphote Corp.
Toledo, Ohio

A contract for 35,000 Cataphote reflecting markers to outline highways in the entire state of Pennsylvania has been awarded to Western Cataphote Corporation, Toledo, Ohio, it was announced by William Searight, general sales manager.

"These reflectors were selected according to strict specifications for brilliancy, dependability and long life without deterioration," he declared. "Cataphote reflecting outliners have been installed in the Pennsylvania Turnpike." It is claimed that this type of reflector returns light in the direction of its source only and cannot be seen by low flying planes or others not in the path of the light.

EMCO Executives Called For Military Service

Pittsburgh Equitable Meter Co.
Pittsburgh, Pa.

Three executives of the Pittsburgh Equitable Meter Company have recently been called for active military duty in different branches of the service.

Colonel W. F. Rockwell, president of the company, was called for extended active service early in October, reporting to Washington, D. C., where he has been serving as assistant to the chief of the Motor Transport Division.

Captain A. E. Higgins, vice-president of the company, originally called in mid-summer for active duty in the Air Corps, has been temporarily deferred due to certain National Defense activities in which the Pittsburgh firm is engaged.

For the past eight months, captain J. R. Sproat of the sales staff has been serving with the 176th Field Artillery in command of Battery "F" at Fort Meade.

A Manual on Ice Control

Calcium Chloride Association
4145 Penobscot Bldg., Detroit, Mich.

With the need for uninterrupted and safe winter traffic assuming even greater importance than ever this year, engineers and public officials will be interested in the latest manual on highway ice control issued by the Calcium Chloride Association. This new, fully illustrated bulletin, based on the practical experiences of nearly every ice-fighting state, covers all phases of ice control practice—from organization of the skidproofing program to actual use of methods, materials and equipment.

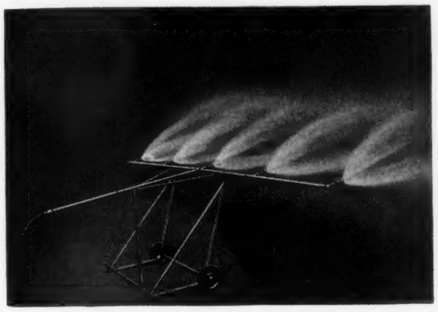
Copies of this 36-page handbook, in convenient pocket size, are available without charge by addressing the Association and asking for Bulletin No. 27.

Pump Adaptation

Pomona Pump Co.
208 E. Commercial St., Pomona, Calif.

Practical information concerning pump adaptation for a wide range of duties under varying conditions is the theme of the new industrial catalog just published by Pomona Pump Co.

This brochure contains not only a profusion of illustrated case histories of varied applications, but also presents many practical drawings for laying in this type of pump. A free copy will be supplied by calling or writing the company.



Russell Skating Pond Spray.

Skating Pond Spray

Russell Mfg. Co., Platteville, Wis.

As shown in the illustration, this spray makes it easy to transform small empty lots, tennis courts, and similar areas to outdoor skating rinks. The cost of the outfit and for operating is small.

The unit may be used with 300 feet of ¾ inch garden hose with a hydrant pressure of 55 lbs.

Larger spray equipment is available for surfacing large areas. Ask for descriptive literature.

Revised Asphalt Construction Specifications

RM-1—Specification for asphaltic road mix surface course (macadam aggregate type).

RM-2—Specification for asphaltic road mix surface course (dense graded aggregate type).

S-1—Specification for asphalt surface treatment or retreatment of old bituminous surfaces.

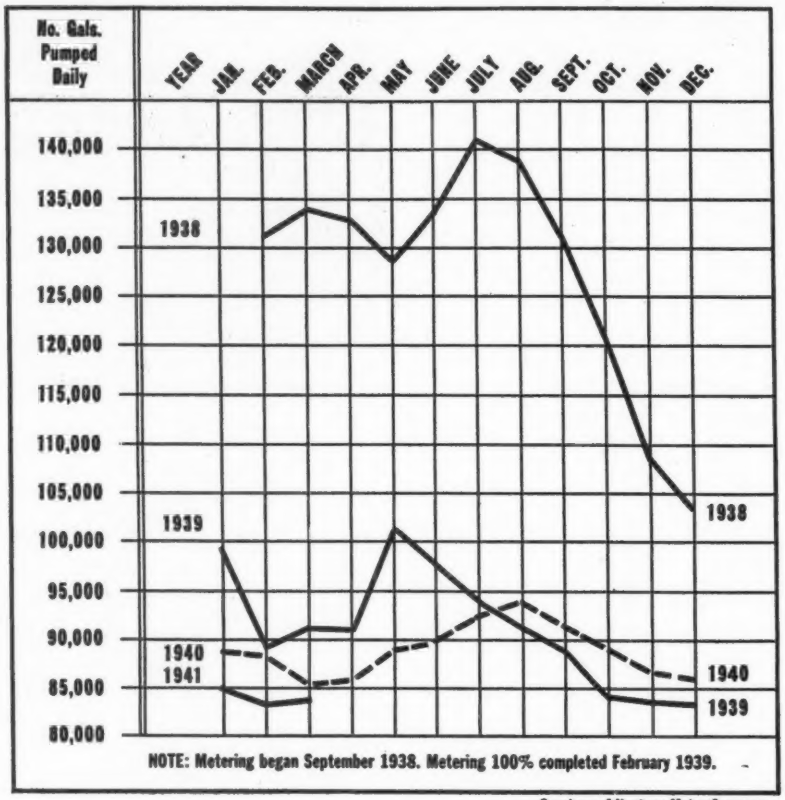
Changes were made to conform with present-day practice, and also to incorporate the latest revisions of cut-back asphalt specifications.

Single copies of these specifications are available, without charge, upon request to the Asphalt Institute, 801 Second Avenue, New York, N. Y.

A Correction

In an item published on page 52 in our November issue headed, "S-P Steel Service Pipe — Coated and Cement Lined," it might be inferred that Hill, Hubbell Co. make the pipe. The facts are that the Steel Pipe manufacturers make the pipe and line it with cement. Hill, Hubbell apply the exterior coating and wrapping.

PEOPLE . . . Here and There



Courtesy of Neptune Meter Company

Leesburg Shows Way to Meet Water Waste Problem

The problem of waste in water consumption has become pressing in hundreds of communities where water resources must be husbanded in order to take care of demands created by the mushrooming new industrial establishments devoted to National Defense manufactures.

The chart reproduced here graphically depicts the experience of Leesburg, Va.—shows the influence of metering service connections.

In 1938, beginning with September, meters were installed on 58 of the town's 460 taps. The town became 100% metered in February, 1939, with 500 taps; and in 1940, continuing into 1941, the number of metered taps was increased to 504. Note the sharp drop in water consumption.

Leesburg's experience is fairly typical of the drastic curb on water waste to be effected through metering. Similar results, proportionate to the number of metered outlets, have been reported from every town or city that has become 100% metered.

New Jersey Sewage Works

Twenty-seventh annual meeting of the New Jersey Sewage Works Association will be held on March 5th and 6th, 1942, at the Stacy-Trent Hotel, Trenton, N. J. John R. Downes, Plainfield, N. J., secretary.

New A.P.W.A. Officers

At the annual meeting of the American Public Works Association recently held in New Orleans, the following officers were elected for the ensuing year:

President, Frederick T. Paul, city engineer, Minneapolis, Minn.; first vice-president, Henry L. Howe, city engineer, Rochester, N. Y.; second vice-president, Frederick R. Storrer, city engineer, Dearborn, Mich.; treasurer, Stuart M. Weaver, executive secretary to the Board of Commissioners, Montclair, N. J.

New Appointments

The following appointments were recently reported:

City Engineers:

F. H. Powe, Sylacauga, Ala.
A. B. Herndon, Orlando, Fla.
C. M. Dixon, West Point, Ga.
Cleon V. Dawson, Beardstown, Ill.
Jacob L. Bryant, Rockport, Ind.
L. A. Martindale, El Dorado, Kan.
E. J. Allison, Hays City, Kan.
Walter C. Devine, Brookline, Mass.
F. L. Britt, Hertford, N. C.
J. S. Osborne, Kent, Ohio.
Raymond Ferguson, Pawhuska, Okla.
E. Bacot, Conway, S. C.
J. M. Jones, Corsicana, Tex.

City Managers:

A. P. Hancock, Amarillo, Tex.
G. K. Patton, Abingdon, Va.
Charles B. Borland, Norfolk, Va.
H. F. Knoell, Orange, Va.

Supt. Public Works:

William B. Clarke, St. Charles, Ill.

County Engineers:

James E. Dunlap, Tuolumne Co., Sonora, Calif.
Wesley Ball, Amite Co., McComb, Miss.
E. H. Wagle, Platte County, Platte City, Mo.
L. E. Quick, Johnson Co., Warrensburg, Mo.
H. C. Alshouse, Seward Co., Gresham, Nebr.
Gilbert Clark, Cheyenne Co., Sidney, Nebr.
Earl Watkins, Licking Co., Newark, Ohio.
Charles W. Smith, Grundy Co., Altamont, Tenn.
Charles E. Neville, Lewis Co., Chehalis, Wash.
Ray Heath, King Co., Seattle, Wash.

Water Works Superintendents:

E. M. Stickney, Mobile, Ala.
A. T. Bazemore, Sylacauga, Ala.
E. W. Lawrence, Newport, Ark.
A. F. Poulter, Bakersfield, Calif.
Philip Ferkovich, Walsenburg, Colo.
S. J. Tankersley, Ocala, Fla.
A. V. Rosser, Cairo, Ga.
Fred H. Schumacher, Beardstown, Ill.
W. F. Marberry, Metropolis, Ill.
John E. Jessen, Monmouth, Ill.
John Dixon, Silvis, Ill.
R. Jos. Panzer, Summit, Ill.
Robert Jackson, Veedersburg, Ind.
Raymond R. Saunders, Grinnell, Iowa.
Don L. Buth, Lake City, Iowa.
Walter Molis, Muscatine, Iowa.
L. E. Nye, Shenandoah, Iowa.
W. J. Reynolds, Jr., Emporia, Kan.
H. H. Huffman, Topeka, Kan.
B. E. Payne, Louisville, Ky.
Alex Cameron, Orono, Me.
C. J. Marson, Presque Isle, Me.
Richard Shields, Rumford, Me.
Kenneth F. Knowlton, Beverly, Mass.
Kenneth E. Russell, Dalton, Mass.
H. D. Lamson, Foxboro, Mass.
Charles W. Smallwood, Charlotte, Mich.
Tony Eikey, Traverse City, Mich.
Thomas J. Skinker, St. Louis, Mo.
Andrew S. Reiff, Hastings, Nebr.
Ralph Lancaster, Kearney, Nebr.
J. Roy Carter, Norfolk, Nebr.
J. C. Rickards, Jr., Canton, N. C.
Robert Van Sleen, Gastonia, N. C.
E. M. Johnson, Raleigh, N. C.
Elmer Dishong, E. Palestine, Ohio.
I. P. Adkins, Shelby, Ohio.
Philip P. Saylor, Bellefonte, Pa.
Weldon Howell, Paris, Tenn.
W. E. Seaholm, Austin, Tex.
F. A. Elliston, Eagle Pass, Tex.
H. H. Houtchens, Electra, Tex.
J. C. McVea, Houston, Tex.
Oren J. Payne, Pampa, Tex.
J. M. Lloyd, Tyler, Tex.
L. R. McClung, Danville, Va.
Wm. E. Febry, Beloit, Wis.
Merle Clapper, Delavan, Wis.
H. H. Brown, Milwaukee, Wis.

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Asphaltic Limestone

5. Characteristics, methods of laying, and results with cold lay mixture shipped ready to use. Especially adapted to resurfacing old pavements, sealcoats and airport runways. Alabama Asphaltic Limestone Co., Liberty Nat. Life Bldg., Birmingham, Ala.

Bituminous Mixer

7. Exact control by volumetric proportioning. Continuous mixing and large capacity. The Barber-Greene mixer can be used as a unit of a travel plant or as a central plant. Excellent and instructive. Well illustrated book on request. Barber-Greene Co., Aurora, Ill.

Cement Dispersion

8. "Economics of Cement Dispersion and Pozzolith" tells the complete story of how cement dispersion reduces water required up to 20% and increases workability 150%. Write The Master Builders Co., Cleveland, Ohio, for a copy.

Cold Mix Plants

10. New catalog and prices of Portable Bituminous Mixers in 6 to 14 ft. sizes for resurfacing and maintenance. Issued by The Jaeger Machine Co., 400 Dublin Ave., Columbus, Ohio.

Concrete Accelerators

29. "How Cotton Quilts are being used successfully for curing concrete" is a series of reprints from recent magazines available on request from Highway Materials Dept., National Automative Fibres, Inc., Little Falls, N. Y.

30. "How to Cure Concrete," a forty-seven page manual published by the Dow Chemical Company, Midland, Michigan, treats fully subject suggested by title.

31. New 48-page booklet in five sections explains clearly the effects, advantages and methods of using Calcium Chloride and Portland Cement mixes. Complete and packed with practical information; well illustrated; pocket size. Sent free on request by Solvay Sales Corp., 40 Rector St., New York, N. Y.

33. Pocket manual of concrete curing with calcium chloride. Complete, handy. Contains useful tables, well illustrated. Write the Columbia Chemical Division, Pittsburgh Plate Glass Co., 30 Rockefeller Plaza, N. Y. C.

Concrete Mixers

44. Catalog and prices of Concrete Mixers, both Tilting and Non-Tilt types, from 3½S to 56S sizes. The Jaeger Machine Company, 400 Dublin Ave., Columbus, Ohio.

Concreting in Winter

47. "Build Straight Through the Cold Weather Season" explains briefly how to obtain satisfactory winter concrete in less time. Write Michigan Alkali Co., 60 East 42nd St., New York, N. Y.

Drainage Products

70. Standard corrugated pipe, perforated pipe and MULTI PLATE pipe and arches — for culverts, sewers, subdrains, cattlepasses and other uses are described in a 48-page catalog entitled "ARMCO Drainage Products," issued by the Armco Drainage Products Association, Middletown, Ohio, and its associated member companies. Ask for Catalog No. 12.

71. Modern Culvert Practice — a 72 page book containing valuable data and tables will be sent promptly to anyone interested in drainage by Gohi Culvert Mfrs., Inc., Newport, Ky.

72. "3 Answers to Limited Headroom," a comparison of three ways of providing safe strength and adequate drainage under limited headroom. For copy ask Armco Drainage Products Assn., Middletown, Ohio.

73. "Principles of Design of Airport Drainage" and other articles on airport drainage reprinted from PUBLIC WORKS Magazine are being distributed free by Bowerston Shale Co., Bowerston, O., Hancock Brick & Tile Co., Findlay, O., and Columbus Clay Mfg. Co., Blacklick, O. Address anyone of the above for a copy.

Mud-Jack Method

107. How the Mud Jack Method for raising concrete curb, gutter, walls and street solves problems of that kind quickly and economically without the usual cost of time-consuming reconstruction activities — a new bulletin by Koehring Company, 3026 West Concordia Ave., Milwaukee, Wis.

Paving Materials, Bituminous

111. An excellent booklet issued by The Barrett Co., 40 Rector St., New York, N. Y., describes and illustrates the uses of each grade of Tarvia and Tarvialithic; 32 good illustrations.

114. COLPROVIA PAVING PROCESSES for non-skid pavements include Plant Mixes by both the Heated and Cold Processes, Road Mix Process and Surface Treatment Process. New literature covering these processes is available from Colprovia Roads, Inc., 183 East Main St., Rochester, N. Y.

Paving Materials, Brick

116. "New Developments in Brick Pavements." A review of the developments in brick pavements in recent years. Issued by the National Paving Brick Association, National Press Building, Washingon, D. C.

Pumps

121. New illustrated catalog and prices of Jaeger Sure Prime Pumps, 2" to 10" sizes, 7000 to 220,000 G.P.H. capacities, also Jetting, Caisson, Road Pumps, recently issued by The Jaeger Machine Company, 400 Dublin Ave., Columbus, Ohio.

122. CMC pump bulletin illustrates and describes complete line of modern centrifugals made in sizes from 1½" to 10" by Construction Machinery Co., Waterloo, Iowa.

123. New brochure by Gorman-Rupp Co., Mansfield, Ohio, illustrates and describes many of the pumps in their complete line. Covers heavy duty and standard duty self-priming centrifugals, jetting pumps, well point pumps, triplex road pumps and the lightweight pumps.

124. 16-page illustrated bulletin, SP-37, describes and illustrates complete C. H. & E. line of self-priming centrifugal pumps from ½" to 8", including lightweight models for easy portability. C. H. & E. Mfg. Co., 3841 No. Palmer St., Milwaukee, Wis.

Retaining Walls

126. Charts showing the design of cellular or bin-type metal retaining walls, helpful suggestions on their use for stabilizing slopes, preventing stream encroachment, and solving problems of limited right of way, and construction details are given in a 16-page bulletin entitled, "ARMCO Bin-Type Retaining Walls." It is published by the Armco Drainage Products Association, Middletown, Ohio, and member companies. Ask for Bulletin H-37.

127. See road work as it was done in the 1890's and as it can be done by a full line of this year's road building equipment. See, in this new action picture book, the first reversible roller, 1893 World's Fair Award Grader and how methods have changed. Attractive new booklet AD-1796 recently issued by The Austin-Western Road Machinery Co., Aurora, Ill.

128. Motor Patrol Graders for road maintenance, road widening and road building, a complete line offering choice of weight, power, final drive and special equipment to exactly fit the job. Action pictures and full details are in catalogs Nos. 253, 254 & 255, issued by Galion Iron Works & Mfg. Co., Galion, Ohio.

129. New bulletins illustrate and describe the latest line of Littleford Utility Spray Tanks, Street Marking Units, Street Flushers and Kettles. Littleford Bros., 452 East Pearl St., Cincinnati, Ohio.

130. Toro patching rollers, tractors and mowers for parks, airports, estates, highways and golf courses are pictured and detailed in new illustrated booklet available from Toro Mfg. Co., Minneapolis, Minn.

Rollers

133. New Tu-Ton roller of simple construction for use in rolling sidewalks along highways, playgrounds and other types of light rolling is fully described in a bulletin issued by C. H. & E. Mfg. Co., 3841 No. Palmer St., Milwaukee, Wis.

138. "The Buffalo-Springfield line of road rollers (tandem, 3-wheel, and 3-axle) are described in the latest catalog issued by the Buffalo-Springfield Roller Co., Springfield, Ohio."

139. "Ironeroller" 3 Axle Roller for extra smooth surfaces on all bituminous work. Booklet contains roller data and operation details. Hercules Co., Marion, Ohio.

Skating Pond Sprays

141. How to make safe skating rinks on any vacant lots with the handy Masbruch spray is described in new literature issued by Russell Manufacturing Co., Dept. 2, Platteville, Wis.

Spreader

147. Jaeger Paving equipment, including Mix-in-Place Roadbuilders, Bituminous Pavers, Concrete Bituminous Finishers, Adjustable Spreaders, Forms, etc.—4 complete catalogs of latest equipment in one cover, issued by The Jaeger Machine Company, 400 Dublin Ave., Columbus, Ohio.

Soil Stabilization

150. "High-Service, Low Cost Roads" is one of the newer booklets using an effective combination of picture and text to set forth the principals and advantages of road surface stabilization with calcium chloride. Complete, interesting and well illustrated. 34 pages. Sent by Solvay Sales Corp., 40 Rector St., New York, N. Y.

152. The Columbia Alkali Corpora-

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12-41

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310 East 45th St., NEW YORK

Please send me without obligation the following booklets listed in your READERS'

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Street ....

City .... State ....

Readers' Service Department

(Continued from page 55)

tion, will be glad to furnish to anyone interested complete information dealing with Calcium Chloride Stabilized Roads. This literature contains many charts, tables and useful information and can be obtained by writing Columbia Alkali Div., Pittsburgh Plate Glass Co., 30 Rockefeller Plaza, New York City.

154. "Soil Stabilization with Tarvia"—An illustrated booklet describing The steps in the stabilization of roadway soil with Tarvia will be mailed on request by The Barrett Company, 40 Rector St., New York, N. Y.

Tractors

159. "International Diesel TracTracTors," is a 48-page catalog giving full details of TracTracTors, including action pictures with bulldozers, bullgraders, blade graders, wheel scrapers, elevating graders, etc. Sent promptly by International Harvester Co., 180 North Michigan Ave., Chicago, Ill.

Street and Paving Maintenance

Asphalt Heaters

198. Illustrated Bulletins 15 to 20 describe Mohawk Oil Burning Torches; "Hotstuf" Tar and Asphalt Heaters; Portable Trailer Tool Boxes; Pouring Pots and other equipment for street and highway maintenance, roofing, pipe coating, water proofing, etc. Mohawk Asphalt Heater Co., Frankfort, N. Y.

Dust Control

210. "How to Maintain Roads with Dowflake" is a new 58 page illustrated booklet of information on stabilized road construction. Includes specifications and several pages of reference tables from an engineer's notebook. Issued by Dow Chemical Co., Midland, Mich.

211. A complete booklet on dust control titled, "Dust Control and Road Stabilization," describes the use of Columbia Calcium Chloride for dust control purposes and stabilization of roads. Sent on request by Columbia Alkali Div., Pittsburgh Plate Glass Co., 30 Rockefeller Plaza, New York, N. Y.

212. "Are You Annoyed by Dust?" an illustrated circular telling how to prevent dust with calcium chloride. Sent free by Michigan Alkali Co., 60 East 42 St., New York, N. Y.

Radio Communication, Two Way

250. Valuable information on how cities and towns all over the country have solved their radio communication problems is found in "Motorola Radio Communication Equipment." Write Galvin Mfg. Corp., 4545 West Augusta St., Chiccago, Ill.

Street Markers

300. Street marking simplified by the use of modern, self-contained units capable of handling any kind of striping jobs is the subject of an illustrated bulletin giving also full details of new M-B Street Markers. Sent by Meili-Blumberg Corp., Box PW, New Holstein, Wis.

Snow Fighting

Plows

350. "Frink One-Way Sno-Plows" is a four page catalog illustrating and describing 5 models of One-Way Blade Type Sno-Plows for motor trucks from 1½ up to 8 tons capacity. Interchangeable with V Sno-Plow. Features, specifications and method of attaching. Carl H. Frink, Mfr., Clayton, 1000 Islands, N. Y.

Ice Control

351. "Make Icy Highways Safe for Traffic"—a new bulletin by Michigan Alkali Co., 60 East 42 St., New York, N. Y., tells how to use calcium chloride for modern ice control.

Sanitary Engineering

Activated Alum

354. "Technical Data on Activated Alum and Dustless Blackalum" points out the analytical side of Activated Alum and Blackalum. Write Activated Alum Corp., Curtis Bay, Baltimore, Md.

Aero-Filter

356. "Results Produced by Aero-Filters" is a new pamphlet covering results at Temple, Texas; Paris, Ill.; Webster City, Iowa; and Mason, Mich. Write Lakeside Engineering Corp., 222 West Adams St., Chicago, Ill.

Air Release Valves

357. Automatic Air Release Valves for water, sewage and industrial uses are described and illustrated in new catalog issued by Simplex Valve & Meter Co., 6750 Upland St., Philadelphia, Pa.

Analysis of Water

360. "Methods of Analyzing Water for Municipal and Industrial Use" is an excellent 94 page booklet with many useful tables and formulas. Sent on request by Solvay Sales Corp., 40 Rector St., New York, N. Y.

Activation and Aeration

376. A valuable booklet on porous diffuser plates and tubes for sewage treatment plants. Covers permeability, porosity, pore size and pressure loss data, with curves. Also information on installations, with sketches and pictures, specifications, methods of cleaning and studies in permeability. 20pp. illustrated. Sent on request to Norton Company, Worcester, Mass.

Cleaning Sewers

383. A 20-page booklet describes and illustrates a full line of sewer cleaning equipment—Rods, Root Cutters, Buckets, Nozzles and Flushers. Write W. H. Stewart (Pioneer Mfr. since 1901), Jacksonville, Fla., or P. O. Box 767, Syracuse, N. Y.

384. A new 32-page, illustrated booklet explains how a city can clean its sewers and culverts with its own forces using the up-to-date Flexible Sewer Rod equipment. Illustrates and describes all necessary equipment. Issued by Flexible Sewer Rod Equipment Co., 9059 Venice Boul., Los Angeles, Calif.

Feeders, Chlorine, Amonia and Chemical

387. For chlorinating water supplies, sewage plants, swimming pools and feeding practically any chemical used in sanitation treatment of water and sewage. Flow of water controls dosage of chemical; reagent feed is immediately adjustable. Starts and stops automatically. Literature from % Proportioneers, Inc. % 96 Codding St., Providence, R. I.

Filter Bed Agitator

388. 60-page booklet, "The Mechanics of Filter Bed Agitation," containing engineering data, technical information concerning surface wash and opinions of users will be sent promptly by Activated Alum Corp., Curtis Bay, Baltimore, Md.

Filter Plant Controllers

389. "The Modern Filter Plant" and the uses of Simplex Controllers for operation are described in a handy, 16-page booklet. Charts, data, curves and tables. Simplex Valve and Meter Co., 6750 Upland St., Philadelphia, Pa.

Fire Hydrants

390. Specifications for standard AWWA fire hydrants with helpful instructions for ordering, installing, repairing, lengthening and using. Issued by M. & H. Valve & Fittings Co., Anniston, Ala.

391. See listing No. 410.

Flow Meters

393. The primary devices for flow measurement—the orifice, the pilot tube, the venturi meter and others — and the application to them of the Simplex meter are described in a useful 24-page booklet (42A). Simplex Valve and Meter Co., 6750 Upland St., Philadelphia, Pa.

Gates, Valves, Hydrants

394. Gate, flap and check valves; floor stands and fittings. New catalog No. 34 gives detail information with dimensions for all types of new full line. M. & H. Valve & Fittings Co., Anniston, Ala.

395. Complete booklet with much worthwhile water works data describes fully Ludlow hydrants and valves. Sent on request. Ludlow Valve Mfg. Co., Troy, N. Y.

396. See listing No. 410.

Gauges

398. The full line of Simplex gauges for filtration plants are illustrated and described in catalog issued by Simplex Valve and Meter Co., 6750 Upland St., Philadelphia, Pa.

Hypochlorinators

400. New illustrated booklet W&T 357 describes this simple, inexpensive means of protecting small water supplies such as summer camps, hotels, swimming pools, dairies, etc., as well as for feeding chemical solutions in the water works plant. Contains typical installation sketches. Write "Wallace & Tiernan Co., Inc., Newark, N. J.

Manhole Covers and Inlets

402. Street, sewer and water castings in various styles, sizes and weights. Manhole covers, water meter covers, adjustable curb inlets, gutter crossing plates, valve and lamphole covers, ventilators, etc. Described in catalog issued by South Bend Foundry Co., Lafayette Boul. and Indiana Ave., South Bend, Ind.

Manhole Cover Silencers

403. New bulletin on Tapax for quickly ending noisy manhole covers and small sample free. Write Tapax Mfg. Co., 201 Hoyt Ave., Mamaroneck, N. Y.

Meters, Venturi

405. MS Meters for use with venturi tubes, flow nozzles, etc., in wall, panel, or floor mounting are covered in detail in catalog sent free by Simplex Valve & Meter Co., 6750 Upland St., Philadelphia, Pa.

406. New bulletin illustrates Builders Air Relay system of transmission for the Venturi Meter which is particularly useful for liquids containing suspended solids like sewage. Eliminates corroson, clogged pipes, etc. Write Builders Iron Foundry, Codding St., Providence, R. I.

Meters, Water

407. Complimentary bulletin W529 tells all about Pittsburgh IMO water meters, "the meters that wear in where others wear out." Write Pittsburgh Equitable Meter Co., Pittsburgh, Pa.

Pipe, Cast Iron

408. Handbook of Universal Cast Iron Pipe and Fittings, pocket size, 104 pages, illustrated, including 14 pages of useful reference tables and data. Sent by The Central Foundry Co., 386 Fourth Ave., New York, N. Y.

409. Cast iron pipe and fittings for water, gas, sewer and industrial service. Super-deLavaud centrifugally-cast and pit-cast pipe. Bell-and-spigot, U. S. Joint, flanged or flexible joints can be furnished to suit requirements. Write U. S. Pipe and Foundry Co., Burlington, N. J.

410. "Cast Iron Pipe and Fittings" is a well illustrated 44 page catalog giving full specifications for their complete line of Sand Spun Centrifugal Pipe, Fire Hydrants, Gate Valves, Special Castings, etc. Will be sent promptly by R. D. Wood Co., 400 Chestnut St., Philadelphia, Pa.

Pipe Forms

411. Making concrete pipe on the job to give employment at home is the subject of a new booklet just issued by Quinn Wire and Iron Works, 1621 Twelfth St., Boone, Ia., manufacturers of "Heavy Duty" Pipe Forms. Sent promptly on request.

Pipe, Reinforced Concrete

412. Literature describing the manufacture and installaton of Lock Joint Reinforced Concrete Pressure Pipe for water supply lines and sewer force mains. Lock Joint Pipe Co., Ampere, N. J.

Pipe, Transite

413. Two new illustrated booklets, "Tansite Pressure Pipe" and "Transite Sewer Pipe" deal with methods of cutting costs of installation and maintenance of pipe lines and summarize advantages resulting from use of Transite pipes. Sent promptly by Johns-Manville Corp., 22 East 40th St., New York, N. Y.

Pipe Joints, Sewer

415. How to make a perfect sewer pipe joint—tight, prevents roots entering sewer, keeps lengths perfectly aligned; can be laid with water in trench or pipe. General instructions issued by L. A. Weston, Adams, Mass.

Pipe, 2-inch Cast Iron

417. Generously illustrated booklet de-

scribes McWane 2-inch cast iron pipe and its manufacture in streamlined pipe shop. Write McWane Cast Iron Pipe Co., Birmingham, Ala.

Pumps and Well Water Systems

420. Installation views and sectional scenes on Layne Vertical Centrifugal and Vertical Turbine Pumps fully illustrated and including useful engineering data section. Layne Shutter Screens for Gravel Wall Wells. Write for descriptive booklets. Advertising Dept., Layne & Bowler, Inc., Box 186, Hollywood Station, Memphis, Tenn.

Meter Setting and Testing

430. The most complete catalog we have seen on setting and testing equipment for water meters—exquisitely printed and illustrated 48-page booklet you should have a copy of. Ask Ford Meter Box Co., Wabash, Ind.

Recarbonation

431. Bulletin describes stabilizing lime-softened water by recarbonation, discussing gas production, washing, compressing, drying, and applying the CO(2). International Filter Co., 325 West 25th Place, Chicago, Ill.

Sand Expansion Indicator

432. New bulletin gives full details of Simplex Sand Expansion Indicators for water plants. Write Simplex Valve & Meter Co., 6750 Upland St., Philadelphia, Pa.

434. Be assured of uninterrupted, constant automatic removal of screenings. Folder 1587 tells how. Gives some of the outstanding advantages of "Straightline Bar Screens" (Vertical and Inclined types). Link-Belt Co., 307 N. Michigan Ave., Chicago, Ill.

Steel Sheet Piling

435. Steel sheet piling to speed sewer jobs is covered in illustrated catalog containing complete production specifications. Write Dept. PW-2, The Union Metal Mfg. Co., Canton, Ohio.

436. "Metal Sheeting for Lower Average Job Costs" is a new bulletin about light weight sheeting you can use again and again. Issued by Armco Drainage Products Assn., Middletown, Ohio.

Sewers

437. "ARMCO Sewers" is the title of a 48-page booklet describing the structural and other advantages of ARMCO Ingot Iron. Paved Invert and Asbestos-Bonded pipe for storm and sanitary sewers. Design data and large charts will be found helpful by engineers engaged in the design or construction of sewers. Copies will be sent on request by the Armco Drainage Products Association, Middletown, Ohio, or its associated member companies.

Septic Tanks, Small

438. Septic Disposal Systems, Waterless Toilets, Multiple Toilets for Camps and Resorts, and other products for providing safer sewage disposal for unsewered areas are described and illustrated in data sheets issued by San-Equip Inc., 504 E. Glen St., Syracuse, N. Y.

Sludge Drying and Incineration

440. "Disposal of Municipal Refuse." Complete specifications and description including suggested form of proposal; form of guarantees; statements and approval sheet for comparing bids with diagramatic outline of various plant designs. 48 pages. Address: Morse Boulger Destructor Co., 216-P East 45th St., New York, N. Y.

441. Full information about Nichols modern, efficient gabage and refuse incinerators now available in the Basket Grate, Continuous Grate, Revolving Grate and Monohearth types will be sent promptly by Nichols Engineering and Research Corp., 60 Wall Tower, New York, N. Y.

442. Recuperator tubes made from Silicon Carbide and "Fireclay" Corebusters for maximum efficiency are described and illustrated in bulletin No. 11 issued by Fitch Recuperator Co., Plainfield National Bank Bldg., Plainfield, N. J.

443. Nichols Herreshoff incinerator for complete disposal of sewage solids and industrial wastes — a new booklet illustrates and explains how this Nichols incinerator works. Pictures recent installations. Write Nichols Engineering and Research Corp., 60 Wall Tower, New York, N. Y.

Swimming Pools

446. Data and complete information on swimming pool filters and recirculation plants; also on water filters and filtration equipment. For data prices, plans, etc., write Roberts Filter Mfg. Co., 640 Columbia Ave., Darby, Pa.

447. 40-page Manual on swimming pools. Includes swimming and pool layouts, specifications, etc., and details concerning Permutit Swimming Pool Equipment. Write The Permutit Co., Dept. G-4, 330 West 42 St., New York, N. Y.

Taste and Odor Control

450. Technical pub. No. 207 issued by Wallace & Tiernan Co., Inc., Newark, N. J., describes in detail taste and odor control of water with BREAK-POINT Chlorination, a method of discovering the point at which many causes of taste may be removed by chlorination with little or no increase in residual chlorine. Sent free to any operator requesting it.

452. "Water and Sewage Chemistry" is the title of a valuable booklet for the operating man, reprinted from PUBLIC WORKS Magazine for December, 1940, by General Chemical Co., 40 Rector St., New York, N. Y.

Treatment

453. "Safe Sanitation for a Nation," an interesting booklet containing thumbnail descriptions of the different pieces of P.F.T. equipment for sewage treatment. Includes photos of various installations and complete list of literature available from this company. Write Pacific Flush Tank Co., 4241 Ravenswood Ave., Chicago, Ill.

455. New booklet (No. 1642 on Link-Belt Circuline Collectors for Settling Tanks contains excellent pictures; drawings of installations, sanitary engineering data and design details. Link-Belt Company, 2045 W. Hunting Park Ave., Philadelphia.

456. New 16-page illustrated catalog No. 1742 on Straightline Collectors for the efficient, continuous removal of sludge from rectangular tanks at sewarage and water plants. Contains layout drawings, installation pictures, and capacity tables. Address Link-Belt Co., 2045 West Hunting Park Ave., Philadelphia, Pa.

457. New illustrated folder (1942) on Straightline apparatus for the removal and washing of grit and detritus from rectangular grit chambers. Address: Link-Belt Co., 2045 W. Hunting Park Ave., Philadelphia, Pa.

458. "Sedimentation with Dorr Clarifiers" is a complete 36-page illustrated catalog with useful design data. Ask The Dorr Company, 570 Lexington Ave., New York, N. Y.

459. A combination mechanical clarifier and mechanical digester, The Dorr Clarigester, is explained and illustrated in a bulletin issued by The Dorr Company, 570 Lexington Ave., New York, N. Y.

460. This new 145 page illustrated chemical products book contains 55 pages of Tables, Factors and valuable Reference Data. Issued by General Chemical Co., 40 Rector St., New York, N. Y.

461. Preflocculation without chemicals with the Dorrco Clariflocculator in a single structure is the subject of a new booklet issued by The Dorr Company, 570 Lexington Ave., New York, N. Y.

462. Dorrco Monorake for existing rectangular sedimentation tanks, open or closed, is described and illustrated in a new catalog sent on request. The Dorr Co., 570 Lexington Ave., New York, N. Y.

Tunnel Liners

480. "Save Money with Armco *Light Duty* Tunnel Liner" is a bulletin you'll want if you are interested in economical, long lasting tunnels. Write Armco Drainage Products Assn., Middletown, Ohio.

Valves (See Gates, Air Release, etc.)

Water Works Operating Practices

490. "Important Factors in Coagulation" is an excellent review with bibliography and outlines of latest work done in the field. Written by Burton W. Graham and sent free on request to Activated Alum Corp., Curtis Bay, Baltimore, Md.

491. "Soft Water for Your Community" tells by means of many interesting pictures and text the advantages of soft water to any community. Ask for a copy from The Permutit Co., Dept. G4, 330 West 42nd St., New York, N. Y.

492. "Alkalies and Chlorine in the Treatment of Municipal and Industrial Water" is a new comprehensive survey filled with tables, charts, cost comparisons, etc., valuable to all who treat large volumes of water. Write Solvay Sales Corp., 40 Rector Street, New York City.

Water Service Devices

500. Data on anti-freeze outdoor drinking fountains, hydrants, street washers, etc., will be sent promptly on request to Murdock Mfg. & Supply Co., 426 Plum St., Cincinnati, Ohio.

For the Engineer's Library

Brief reviews of the latest books, booklets and catalogs for the public works engineer.

Trench Loading Tables for Clay Sewer Pipe

Clay Sewer Pipe Association, Inc.
Oliver Bldg., Pittsburgh, Pa.

The tables in this booklet have been prepared in response to many requests by engineers and others for a method to reduce the time and effort normally required for the estimation of loads falling upon clay pipe sewers, and to provide a ready means of selecting clay sewer pipe of the proper strength classification. Rather than repeat the complex mathematics of making such load computations directly, tables have been developed including solutions for practically all normal sewer and drain trench loading problems.

There are three groups of tables, Group I showing trench loads on pipe of all sizes from 6-inch to 36-inch, inclusive, in soils of four different classifications, varying from sand and gravel to wet clay. These tables give slide-rule solutions of the "Marston" formula as described in Bulletin No. 96 published by the Iowa Engineering Experiment Station at Iowa State College, and entitled "The Theory of External Loads on Closed Conduits in the Light of Latest Experiments." The "Marston" formula is without doubt the most reliable device available for estimating the weights which sewer and drain pipes are called upon to support and is generally recognized by the engineering profession as reliable, giving results which are safe and within the limits of accuracy demanded for economical design. Write for a free copy of this valuable and time saving 56-page booklet.

New Giant Decimal Equivalent Wall Chart

Frederick Post Co.
3650 W. Avondale Ave., Chicago

The new Giant Post Decimal Equivalent Wall Chart is now ready for distribution to those who ask for it on their business stationery.

This Post Chart is really new and greatly different from others we have seen on the walls of drafting rooms.

Its first essential is that it is of giant size 26″ by 39″. Secondly, it's printed in large heavy type 1¼″ high which can be easily read 50 feet away. And lastly, it is printed in two colors, red and black on a white background making it attractive and more important the color separation adds to readability.

This new giant decimal equivalent chart that brings all the equivalents from 1/64 to 63/64 within easy reading of your eyes is really the answer to the "draftsmen's prayers." Write for your copy today—it is yours for the asking without obligation.

Index to ADVERTISEMENTS

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DECEMBER, 1941

PUBLIC WORKS

Streets and Highways • • • Water Works
Sewage Disposal • • Airports

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DECEMBER, 1941

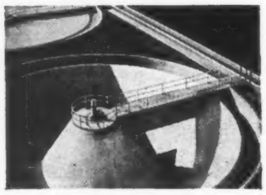
Three groups that vote "YES" on SOFT WATER

INDUSTRY:
Boilerfeed and process water require less treatment at the plant.

HOMES:
Richer soft-water suds mean more luxury, less work.

SHOPS:
Better service, lower costs for laundries, beauty parlors, restaurants, etc.

TWO EASY WAYS TO GET SOFT WATER FOR *YOUR* CITY—AS 575 MODERN MUNICIPALITIES ARE DOING



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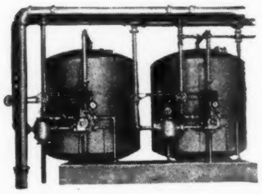
New cold-lime "precipitator" treatment takes only half the space of old-type plants, makes much bigger savings. Installations now in operation handle capacities up to 120,000,000 gallons daily.



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This simple method is fully automatic—no skilled operator is required. Available in a wide range of models and sizes. Permutit has ample stocks of zeolites for immediate delivery.

GET THIS FREE BOOKLET—Interesting, illustrated booklet shows how easy it is to enjoy soft, sparkling, iron-free water in your community. Write to: The Permutit Company, Dept. G4, 330 West 42nd Street, New York, N. Y.

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PERMUTIT

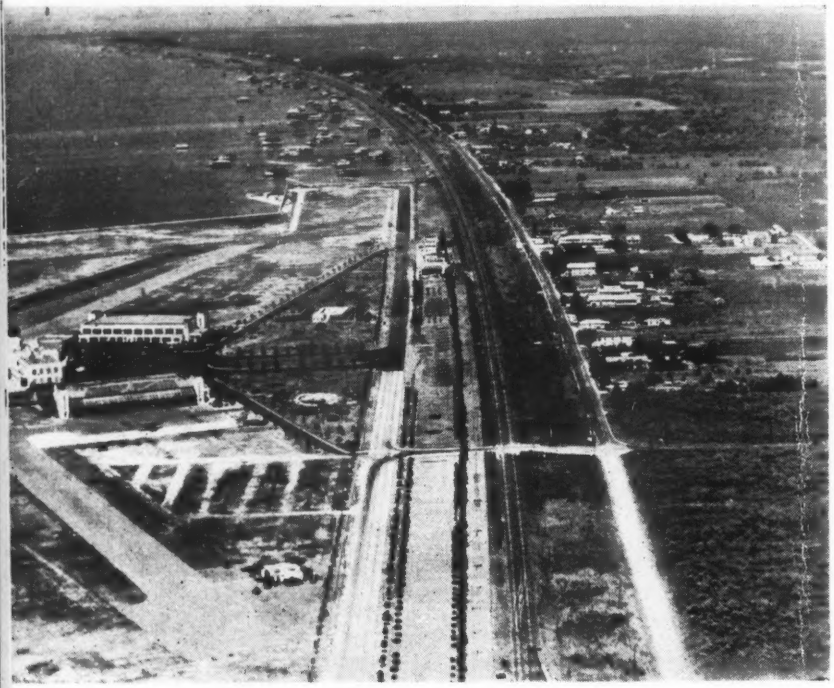
WATER CONDITIONING HEADQUARTERS

When you need special information—consult the *classified* READER'S SERVICE DEPT., pages 55-57

ASPHALTIC LIMESTONE

for Airport Runways

ONE INCH ASPHALTIC LIMESTONE RUNWAY, MERIDIAN, MISS., AIRPORT, LAID ON SLAG MACADAM BASE IN 1936



New Orleans Airport—Alabama Asphaltic Limestone Co.

Meets the 5 MUSTS

Experience proves these five runway paving "musts" to be:

1—Resistance to weathering.

2—Density and toughness.

3—Light color.

4—A not too abrasive surface yet providing good braking resistance.

5—Freedom from loose particles and raveling.

Asphaltic Limestone, laid hot or cold, resists weathering—it will not ravel or weather out, even under the very light traffic that runways get. Write for new Airport Folder P.

BEST FOR STREETS AND HIGHWAYS TOO

In the case of Asphaltic Limestone, airports are but new users of an old product. It is STILL the one best surface for highways and streets, whether traffic is light or heavy.

Asphaltic Limestone is a dense hard limestone impregnated with approximately 4½% of stable, natural bitumen. It is extremely easy to lay on any suitable foundation, either as a "hot mix" or "cold mix." So laid, it will give you a tough, permanent, good looking, good riding, non-skid pavement.

Reasonable first cost and low maintenance distinguish it. Some pavements laid with asphaltic limestone have been serving satisfactorily since 1878.

Detailed specifications and full data on request, including list of these pavements located nearest to you.

ALABAMA ASPHALTIC LIMESTONE COMPANY, BIRMINGHAM, ALA.